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A PRELIMINARY BIOLOGICAL SURVEY OF WATERS IN THE MAYBELLE RIVER, KEANE CREEK, CROWN CREEK, OLD FORT RIVER AND RICHARDSON RIVER DRAINAGES

WILLIAM R. TURNER

SURVEY REPORT NO. 13

Alberta Fish and Wildlife Division

FISHERIES SECTION

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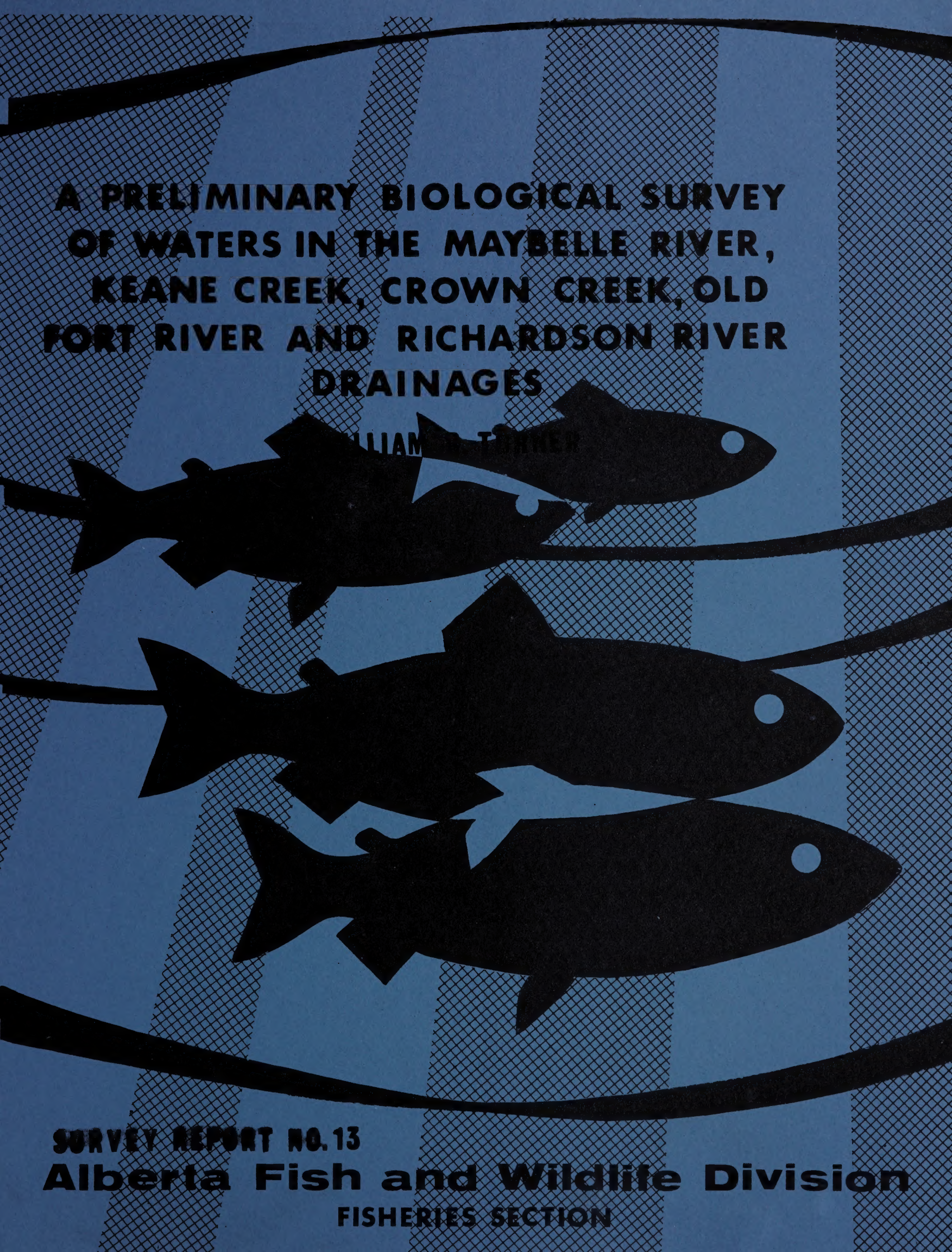

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By

William R. Turner
Fishery Biologist

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Fish and Wildlife Division
Department of Lands and Forests
April 1968

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INTRODUCTION

During the period May 24 to July 20, 1967, nineteen small lakes and four streams were examined in order to determine their potential for sport and commercial fisheries. All were situated in the area of Lake Athabasca, east of the Athabasca River, and northeast of Fort McMurray, Alberta. They included waters in the following drainages: Maybelle River, Keane Creek, Crown Creek, Old Fort River and Richardson River. All these drain into Lake Athabasca or the Athabasca River Delta (Figure 1).

The surrounding country is generally sandy, with jack pines growing on the sandy ridges, and black spruce growing in the muskeg. A large number of small lakes are found in the area, of which only a selected few were surveyed.

There are no records of lakes in the area being commercially fished. The area is inaccessible during the summer except by float plane, and this form of transportation was used by the survey crew.

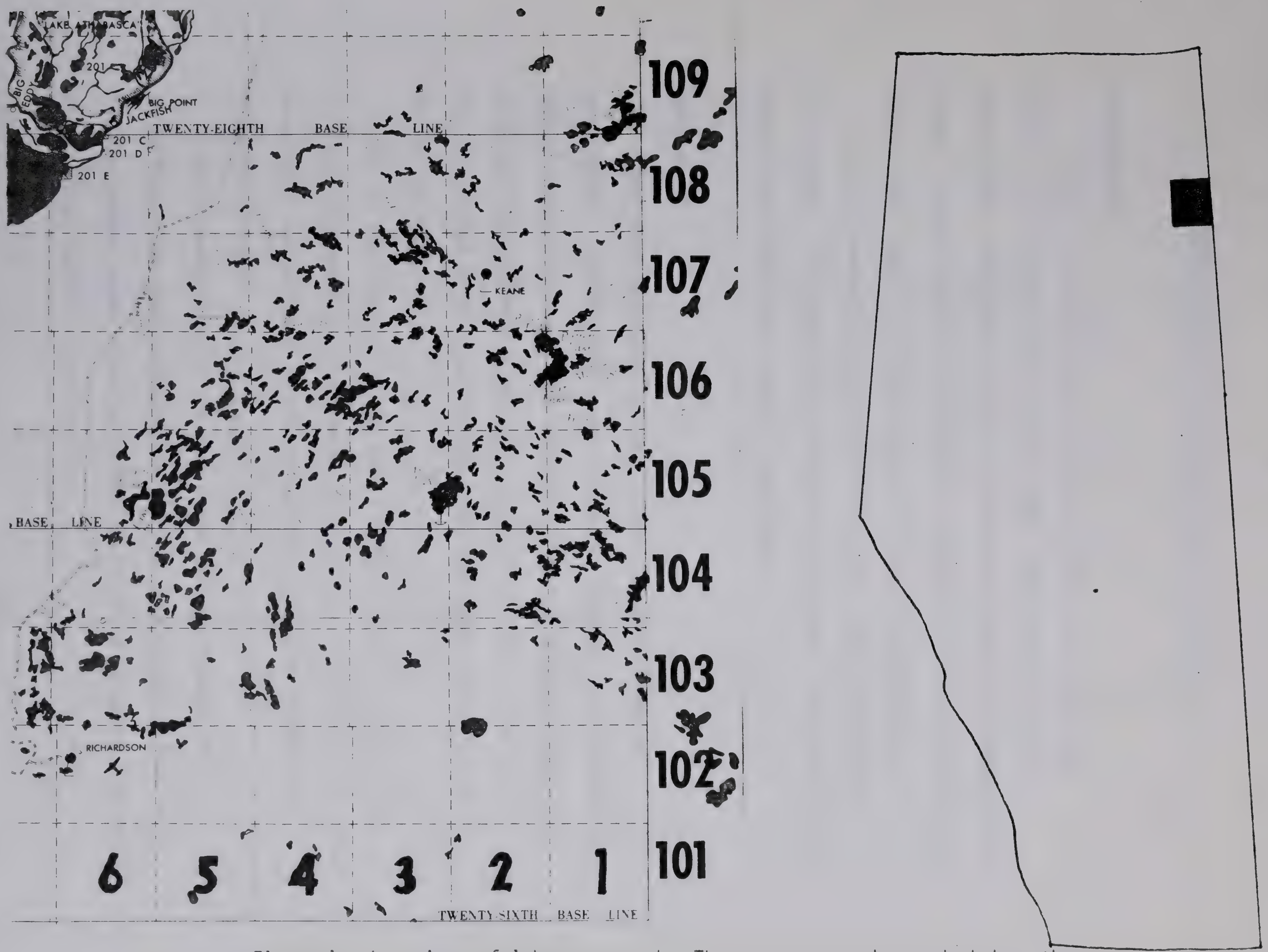


Figure 1. Locations of lakes surveyed. The ones surveyed are shaded on the map.

UNNAMED LAKES ON THE MAYBELLE RIVER (105-5W4th)

INTRODUCTION

Six small lakes adjoining the Maybelle River were surveyed during the period May 24 to June 5, 1967. These small lakes are located about 120 miles north of Fort McMurray, Alberta in Township 105, Range 5, west of the Fourth Meridian. The Maybelle River, which drains these lakes, flows into the Athabasca Delta at Richardson Lake.

The surrounding country consists of sandy ridges interspersed with muskeg. The sandy ridges are covered with small jack pines, while much of the muskeg area supports black spruce.

MORPHOMETRY

Depths were determined on four of the six lakes using an echo sounder. Contour maps were constructed from the data obtained and water volumes calculated from the maps. Other morphometric data was obtained from planimetric maps at a scale of one inch to one mile. For the purpose of this survey, the lakes have been numbered from one to six (Figure 1).

All of the lakes are quite small, ranging from 141 to 640 acres in area. The shoreline development factors range from 1.3 to 2.4, which means that the shoreline on these lakes are regular to moderately irregular (Table 1).

The maximum depths in the four lakes sounded ranged from 21 to 27 feet while the mean depths ranged from 9 to 12 feet. With such shallow basins, these lakes are probably well mixed in summer and there should be no thermal stratification.

Figure 1. Contour map and Lake numbers, Lakes on the Maybelle River.

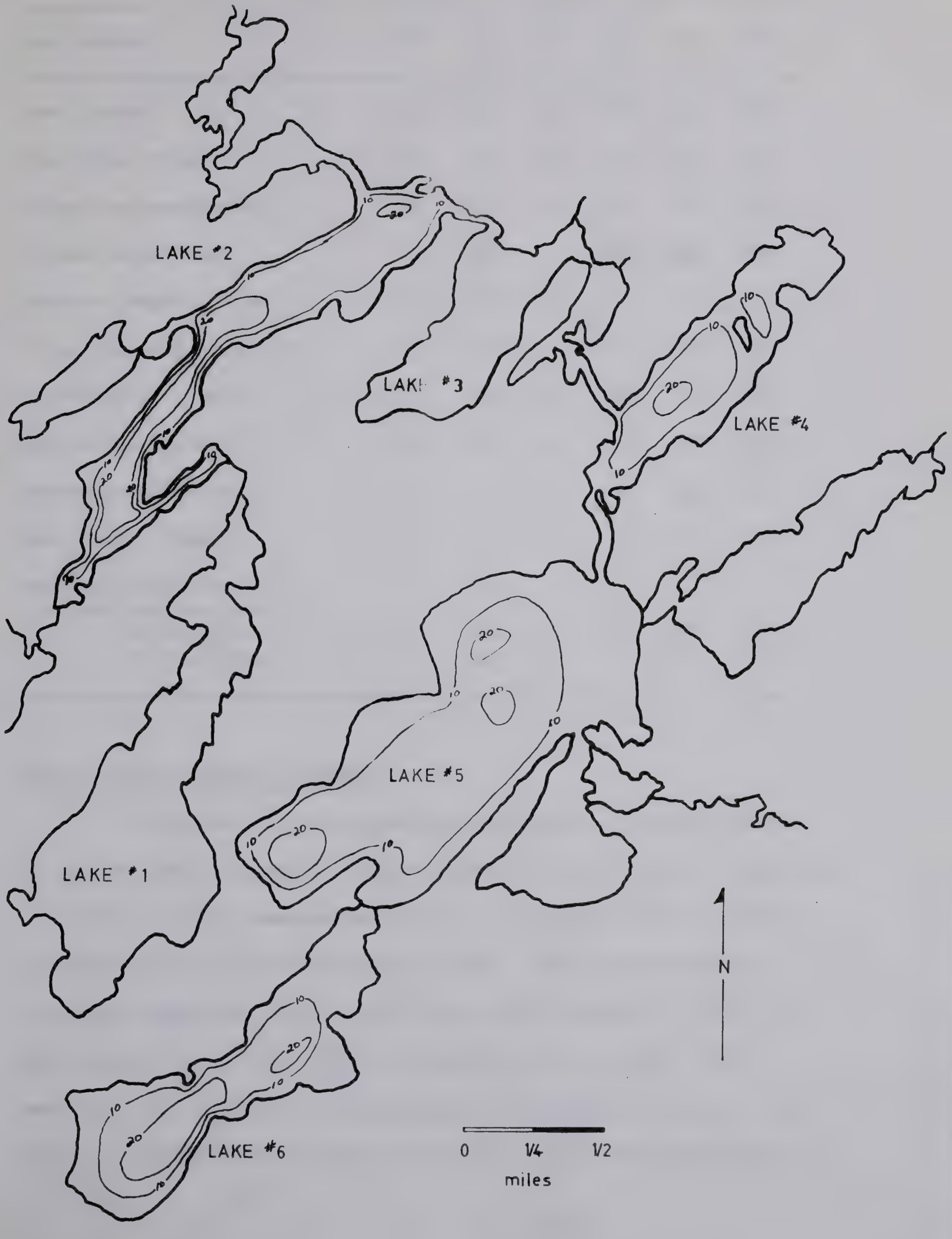


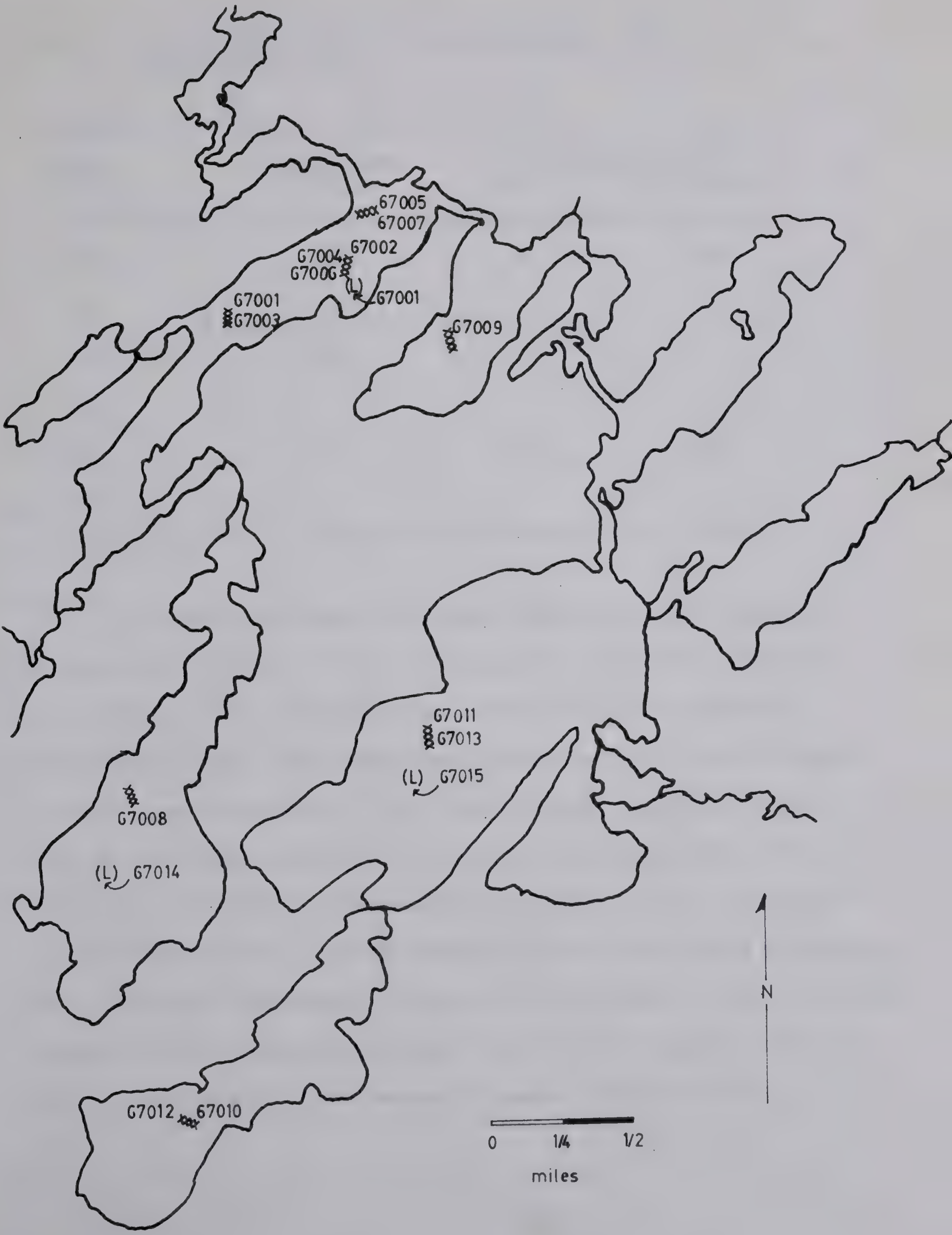
Table I. Morphometry of Unnamed Lakes on the Maybelle River. For Locations, see Figure 1.

Lake Number	#1	#2	#3	#4	#5	#6
Area (acres)	371	339	141	179	640	243
Shoreline (miles)	4.7	615	2.2	3.0	6.2	3.5
Shoreline development	1.7	2.4	1.3	1.5	1.8	1.6
Volume (acre feet)	-	4000	-	1660	6000	2700
Maximum length (miles)	1.9	2.0	1.0	1.2	1.6	1.5
Effective length (miles)	1.5	1.0	1.0	1.2	1.6	1.3
Maximum width (miles)	0.6	0.4	0.4	0.3	1.1	0.5
Mean width (miles)	0.3	0.3	0.2	0.2	0.6	0.3
Maximum depth (feet)	-	27	-	21	22	27
Mean depth (feet)	-	12	-	9	9	11
Depth distribution as percent surface area						
10 feet plus	-	58	-	46	46	53
20 feet plus	-	19	-	4	4	18

PHYSICAL AND CHEMICAL FEATURES

A series of limnological observations was made on Lake #2 on May 25, 1967 (Figure 2). On this date the lake was just beginning to warm up and the temperature profile revealed a range of 2.75° C. from the surface to the bottom at 25 feet. The concentration of dissolved oxygen was high, from 115 to 130% saturation (Table II). The transparency of the water, as measured with a secchi disc, was 6.5 feet. This low value was caused by the brown color of the water, in addition to a substantial amount of allochthonous material

Figure 2. Net sets (xxx) and limnology stations (L) on Lakes on the Maybelle River.



in the water being carried in by the Maybelle River, which was high at the time.

Table II. Observations taken at Limnology Station 67001 on Lake #2, taken May 25, 1967

Depth (feet)	Temperature (° C.)	Dissolved Oxygen p.p.m.	% saturation
0	9.75	15	130
5	9		
10	8.75		
15	8		
20	7.5	14	115
25	7		

Limnological observations were made on Lake #1 (Figure 2) on August 19, 1967, at 1:00 p.m. The depth at the station (#67014) was 11 feet and from the temperature profile the water appeared to be thoroughly mixed. The temperature varied from 19° C. at the bottom to 20.5° C. at the surface. The dissolved oxygen values were high from top to bottom, ranging from 95 to 100% saturation (Table III). The pH was 7.6 at both surface and bottom and the specific conductance (standardized to 18° C.) was 82 mmhos/cm. at both the surface and bottom. The transparency of the water, as measured with a secchi disc, was 9 feet. The water in this lake was not brown in color, but a moderate amount of plankton was present, which reduced the secchi disc visibility.

Table III. Observations taken at Limnology Station 67014 on Lake #1, August 19, 1967.

Depth (feet)	Temperature (° C.)	Dissolved Oxygen p.p.m.	Dissolved Oxygen % saturation	pH	Conductance (mmhos/cm @ 18°C.)
5	20.5	9	100	7.6	82
5	19.75				
10	19	9	95	7.6	82
11	19				

Limnological observations were made on Lake #5 (Figure 2) on August 19, 1967, at 1:30 p.m. The depth at the station (#67015) was 19 feet and there were some temperature and chemical differences between the surface and bottom waters (Table IV). These differences do not appear very significant and the lake is probably well mixed. The transparency of the water, as measured with a secchi disc, was 6 feet. The color of the water was quite brown, and this, coupled with a substantial amount of allochthonous material in the water, reduced the transparency of the water in this lake.

Table IV. Observations taken at Limnology Station 67015 on Lake #5, August 19, 1967.

Depth (feet)	Temperature (° C.)	Dissolved Oxygen p.p.m.	Dissolved Oxygen % saturation	pH	Conductance (mmhos/cm @ 18°C.)
0	19.75	9	95	7.4	76
5	18.5				
10	17.5				
15	17				
19	16	8	80	7.3	75

Two water samples were taken at limnology station 67014 on Lake #1 and two were taken at limnology station 67015 on Lake #5 on August 19, 1967. There are differences between the waters in the two lakes, particularly in pH and specific conductance (Table V). This is not surprising, as those lakes which are right on the Maybelle River (Lakes 2, 3, 4 and 5, Figure 1) have brown-colored water containing a substantial amount of allochthonous material, while Lakes 1 and 6 have clearer water.

Table V. Water chemistry taken on Lake #1 and Lake #5, August 19, 1967.

Lake Number	#1	#1	#5	#5
Temperature (° C.)	20.5	19	19.75	16
Depth (feet)	0	10	0	19
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	50	60	50	45
Calcium hardness (p.p.m. $CaCO_3$)	35	25	35	35
Total hardness (p.p.m. $CaCO_3$)	40	40	35	35
Chlorides (p.p.m.)	5	10	5	5
pH (Hellige)	7.6	7.6	7.4	7.3
Specific conductance (mmhos/cm @18°C.)	82	82	76	75

The limnology and water chemistry indicate that the lakes in this group fall into two categories. Lakes 1 and 6 have clear water and are eutrophic. The other lakes, however, have very brown water and large amounts of allochthonous materials brought in by the Maybelle River. As a result these lakes are less productive.

PLANKTON

One total vertical plankton haul was made at limnology station 67001 (Lake #2) on May 25, 1967. The plankton was sparse at this time. The only plankters in the haul were diatoms, Tabellaria and Fragilaria being common, while Melosira was rare. No other types of phytoplankton were found in the sample and no zooplankters were noted.

A total vertical plankton haul was taken on Lake #1 at limnology station 67014 on August 19, 1967. The plankton was quite abundant at this time. The phytoplankton consisted of diatoms, blue-green algae and dinoflagellates. The diatoms were represented by Fragilaria, which was abundant, Tabellaria and Melosira, which were common, while Asterionella was scarce. The blue-green algae included Microcystic, which was abundant, Anabaena and Gomphosphaeria, which were common, while Gloeotrichia was scarce. The dinoflagellate Ceratium was abundant. Rotifers (two species) were very abundant. Of the larger zooplankters, only copepod nauplii were found in any abundance, while Leptodora kindtii was present in small numbers. No cladocerans were found in the sample.

A total vertical plankton haul was taken on Lake #5 at limnology station 67015 on August 19, 1967. The plankton was quite abundant at this time. The phytoplankton consisted of diatoms, green algae, blue-green algae and dinoflagellates. The diatoms were represented by *Asterionella*, which was very abundant, *Tabellaria*, which was abundant, and *Fragilaria*, which was scarce. The blue-green algae were represented by *Microcystis* and *Gloeotrichia*, both of which were common. The green algae consisted of *Ulothrix*, which was common, and *Staurastrum*, which was rare. The dinoflagellate *Ceratium* was scarce in the sample. Of the zooplankters, the rotifers were abundant, as also were cladocerans of the genus *Daphnia*. Adult copepods were scarce in the sample but nauplii were common.

Since the first plankton sample was taken so early in the season, it tells us little about the lake concerned. The other two samples were taken in August, and show the plankton to be quite varied in these lakes (Table VI). There are some differences between the plankton samples from Lakes 1 and 5, and this may reflect chemical differences in the waters of the two lakes.

Table VI. Plankton from Unnamed Lakes on the Maybelle River (105-5-W4th) The relative abundance of the organisms present is indicated as follows: very abundant--va, abundant--a, common--c, scarce--s, rare--r, or absent--x

Organism	Lake #2	Lake #1	Lake #5
Diatoms			
Asterionella	x	s	va
Fragilaria	c	a	s
Melosira	r	c	x
Tabellaria	c	c	a
Blue-green algae			
Anabaena	x	c	x
Gloeotrichia	x	s	c
Gomphosphaeria	x	c	x
Microcystis	x	a	c
Green algae			
Staurastrum	x	x	r
Ulothrix	x	x	c
Dinoflagellates			
Ceratium	x	a	s
Rotifers	x	va	a
Crustaceans			
Leptodora kindtii	x	r	x
Daphnia	x	x	a
Cyclops (adults	x	x	s
Copepod nauplii	x	a	c

BOTTOM FAUNA

Twenty-six bottom samples were taken from the six lakes between May 25 and June 3, 1967 (Figure 3). Each sample consisted of the specimens from four hauls with a six-inch square Ekman dredge, after washing through a screen bottomed bucket (25 meshes per inch). These were divided into major groups, counted and their displaced volumes determined in the laboratory.

From the bottom sample results (Table VII) it can be seen that the substrate was either of sand or organic muck throughout most of the lakes. All dredgings shallower than ten feet were in sand, while most of those deeper than ten feet were in organic muck. In Lakes 2, 3, 4 and 5, this substrate contained a fair amount of fiber and had a reddish brown color, while in Lakes 1 and 6 the organic muck was dark brown and well decomposed.

Most of the shoreline on all six lakes consisted of sand, except in the delta area where the Maybelle River entered Lake #5. In this area there were some mud flats. Rooted aquatic vegetation was abundant in most areas shallower than ten feet, which comprises a large portion of these lakes. The invertebrate fauna associated with this vegetation was not sampled, but must add substantially to the standing crop of fish food organisms in the lake during the summer months.

The average standing crop of bottom organisms during the survey was found to be 523 organisms per square meter, with a volume displacement of 2.88 c.c. per square meter. This is quite low and may indicate that some edaphic factor is reducing the productivity of these lakes.

Figure 3. Bottom sampling stations on Unnamed Lakes on the Maybelle River.

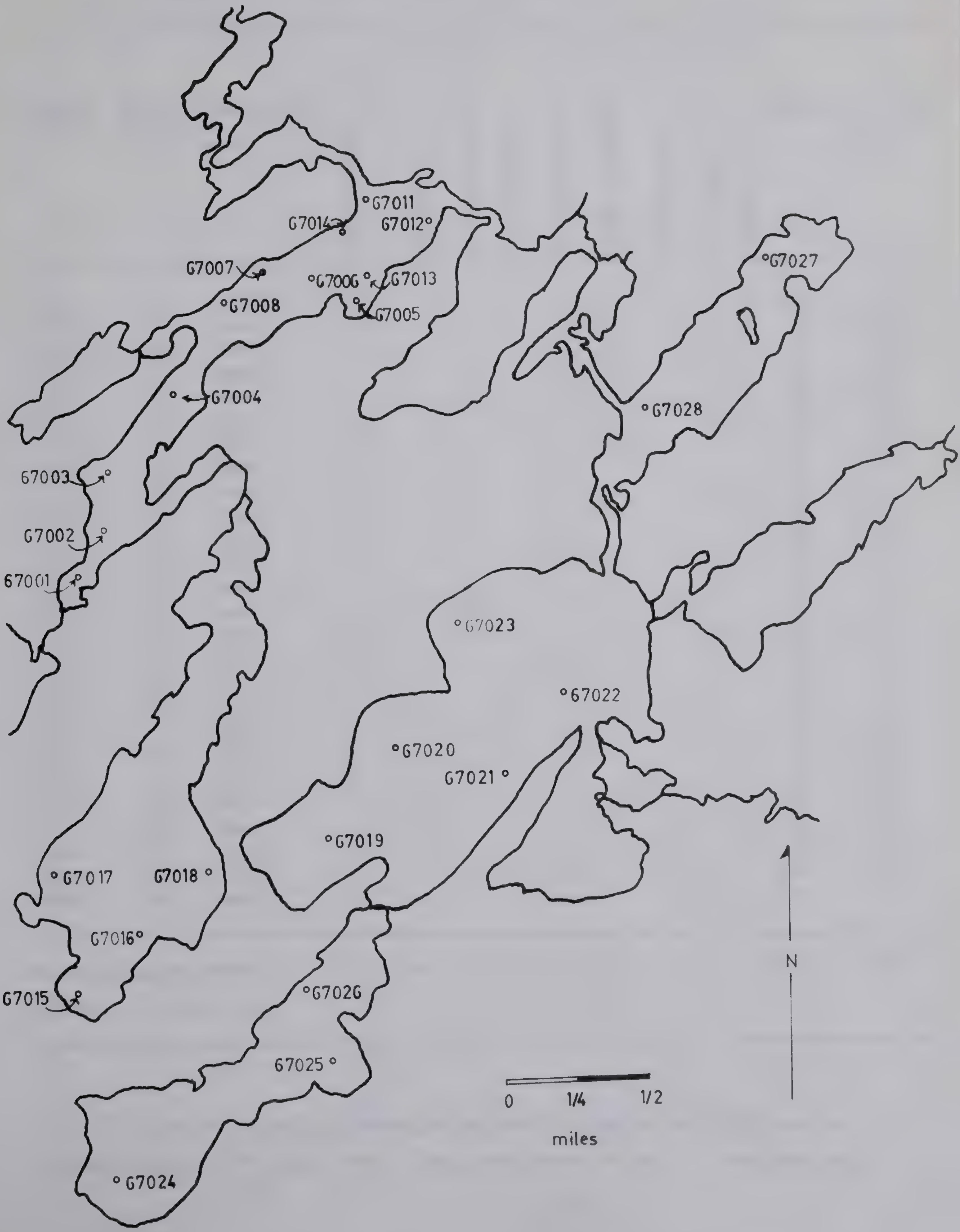


Table VII. Bottom Fauna from Unnamed Lakes on the Maybelle River (105-5-W4th). Each sample consists of four hauls with a six inch square Ekman dredge (Figure 3). The samples were taken between May 25 and June 3, 1967.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Amphipoda	Ephemeroptera	Trichoptera	Chironomidae	Other Diptera	Gastropoda	Pelecypoda	Others	Total	Displaced Volume (c.c.)
67001	14	Muck	-	-	-	-	72	1	-	-	-	73	0.20
67002	20	Muck	-	-	-	-	16	4	-	1	-	21	0.15
67003	24	Muck	-	-	-	-	5	10	-	-	-	15	0.10
67004	21	Muck	-	1	2	-	11	5	-	3	-	22	0.20
67005	4	Sand	-	20	16	2	33	-	5	2	-	78	0.65
67006	22	Muck	2	2	-	-	12	20	-	3	-	39	0.30
67007	19	Muck	4	-	-	-	17	4	-	2	-	27	0.35
67008	12	Muck	1	1	4	-	15	-	-	-	-	21	0.05
67011	16	Muck	-	-	1	-	11	-	-	-	-	12	0.30
67012	4	Sand	4	-	17	-	20	-	-	-	3	44	0.25
67013	14	Sand	-	-	4	-	30	-	-	-	-	34	0.25
67014	16	Muck	-	3	-	-	22	-	-	2	-	27	0.05
67015	16	Muck	-	-	3	-	20	-	-	1	-	24	0.35
67016	7	Sand	4	40	71	-	10	-	-	-	-	125	1.10
67017	13	Muck	10	63	15	3	11	-	-	9	-	111	0.40
67018	20	Muck	-	-	-	-	20	7	-	-	-	27	0.20
67019	21	Muck	5	-	-	-	84	-	-	-	-	89	0.35
67020	16	Muck	1	-	-	-	26	-	-	6	-	33	0.10
67021	21	Muck	-	-	-	-	30	-	-	-	-	30	0.05
67022	16	Muck	-	-	-	-	6	-	-	-	-	6	0.10
67023	4	Sand	10	100	2	-	15	-	-	-	5	132	0.35
67024	23	Ooze	-	-	-	-	10	-	-	-	-	10	0.10
67025	13	Sand	-	20	-	-	46	-	-	1	-	67	0.15
67026	6	Sand	-	-	-	1	14	-	-	-	-	15	0.20
67027	8	Sand	-	-	1	-	113	-	-	1	-	115	0.30
67028	20	Muck	-	-	-	-	15	1	-	2	1	19	0.10
Average/square meter			17	104	56	2	283	22	2	12	4	523	2.88
Percent of total no.			3	21	11	1	56	4	1	3	1		

The Chironomidae dominate the bottom fauna, being 56 percent of the total number of organisms. They were found in all of the samples.

Amphipoda were also quite numerous, comprising 21 percent of the total number of organisms. Ephemeroptera, although only 11 percent by number, represent a fairly large biomass, as most of the mayflies found were quite large. All other organisms were relatively insignificant in number and volume.

FISH FAUNA

Test nets were set thirteen times between May 25 and June 4, 1967. Each gang was 200 yards long and consisted of 50 yards of each of 2½, 3½, 4½ and 5½ inch mesh (stretch measure) nets. The gangs were set in various locations (Figure 2) and generally those closer to the Maybelle River had poorer catches.

The fish caught included northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*), lake whitefish (*Coregonus clupeaformis*), tullibee (*Coregonus artedi*), white suckers (*Catostomus commersoni*) and longnose suckers (*Catostomus catostomus*).

Table VIII. Test Net Results, Unnamed Lakes on Maybelle River (105-5-W4th).

Net Set No.	Depth (feet)	Northern Pike	Walleye	Lake Whitefish	Tullibee	White Suckers	Longnose Suckers	Total
67001	20	6	-	-	1	-	-	7
67002	18	5	2	2	1	-	-	10
67003	20	3	-	-	-	-	-	3
67004	18	4	2	1	-	-	-	7
67005	8	6	4	-	1	3	-	14
67006	18	10	1	1	-	-	-	12
67007	8	16	3	1	-	2	-	22
67008	15	9	5	19	1	-	-	34
67009	10	8	2	4	1	-	-	15
67010	20	4	-	7	-	-	-	11
67011	20	5	3	1	2	1	3	15
67012	20	32	4	25	-	-	-	61
67013	20	27	9	10	21	5	1	73
Totals		135	35	71	28	11	4	284

Most of the pike were caught in the 2½ and 3½ inch mesh nets, while few were caught in the 4½ inch mesh and none in the 5½ inch mesh nets. Most were quite small. The walleye were caught largely in the 3½ inch mesh, while the lake whitefish were caught mostly in the 4½ inch mesh nets. The tullibee, being quite small, were caught mostly in the 2½ inch mesh nets (Table IX).

Table IX. Summary of Test Net Results, Unnamed Lakes on the Maybelle River (105-5-W4th). The Mesh Size Indicates Stretch Measure in Inches.

Fish Species	Number Caught in Each Mesh Size			
	2½	3½	4½	5½
Northern Pike	44	82	9	0
Walleye	8	20	7	0
Lake Whitefish	1	11	42	17
Tullibee	20	4	4	0
White Sucker	2	3	6	0
Longnose Sucker	0	0	3	1
Totals	75	120	71	18

Pike

One hundred and thirty-five pike were taken, of which sixty-six were examined. The fork length, weight, sex and maturity of each was recorded and scale samples were taken for age determination. The fish in the sample ranged from three to nine years in age and would appear to be maturing in their fourth year and spawning at the beginning of their fifth year.

These pike do not appear to be very fast growing, the largest fish caught being in age class IX, with a fork length of 745 mm and weighing only 2660 grams. The dominant age classes in the sample were age class V and age class VI, these two making up the largest part of the sample (Table X).

Table X. Pike from Unnamed Lakes on the Maybelle River (105-5-W4th).
Number in Sample: 66

Age Class	n	♀♀	No. Mature	Fork Length (mm) $\bar{x}$	$S_{\bar{x}}$	Range	Weight (g) $\bar{x}$	$S_{\bar{x}}$	Range
III+	2	1	0	330		330-331	295		260- 330
IV+	8	3	1	388	±12.5	335-440	393	± 38	190- 565
V+	17	6	15	470	± 4.6	432-496	670	± 26	430- 930
VI+	24	12	24	527	± 6.4	472-597	948	± 43	620-1450
VII+	10	10	10	579	± 6.5	555-607	1174	± 51	960-1540
VIII+	4	2	4	628	± 5.4	620-643	1605	±109	1290-1790
IX+	1	1	1	745			2660		

The habitat for pike in these lakes appears to be quite extensive, as a result of their shallow nature and the large areas of emergent aquatic vegetation. Thus there is no restriction on spawning habitat for this species in these lakes.

The pike would appear to be the most numerous fish in these small lakes from the test net results (Table VIII and Table IX). However, they do not grow to trophy size, and in this area offer little sport fishing at the present, although in the future, if the area becomes easily accessible, they may provide a good sport fishery.

WALLEYE

Thirty-five walleye were taken. Twenty of these were examined and the fork length, weight, sex and maturity of each being recorded. Scale samples were taken for age determination.

Most of the walleye were caught in the 3½ inch mesh nets, although some were caught in the 2½ and 4½ inch mesh, while none were caught in the 5½ inch mesh nets.

Table XI. Walleye from Unnamed Lakes on the Maybelle River (105-5-W4th).
Number in Sample: 20

Age Class	n	OO XX	No. Mature	Fork Length (mm)			Weight (g)		
				$\bar{x}$	$S\bar{x}$	Range	$\bar{x}$	$S\bar{x}$	Range
IV+	4	-	0	302	± 7.2	285-320	275	±22	240- 340
V+	5	3	3	367	±23.5	306-434	574	±88	380- 860
VI+	2	0	1	395		390-400	645		610- 680
VII+	5	2	5	468	± 6.5	447-482	994	±15	940-1030
VIII+	3	3	3	501	± 1.9	499-505	1302	±76	1170-1435
IX+	1	1	1	540			1500		

The fish examined (Table XI) ranged in age from four to nine years of age and would appear to mature at the age five. These fish probably move up and down the river and between the lakes quite extensively.

The habitat for walleye is not very extensive nor is it to be considered optimal. Lakes 1 and 6 probably offer the best habitat for the species. For spawning habitat, Lakes 1 and 6 are the only ones which appear suitable, although many may spawn in the Maybelle River, as it has large stretches of suitable spawning grounds for this species.

The walleye in this area are probably not too plentiful. They did not make up a very large portion of the total catch in the test gangs set in these lakes. This probably results from a lack of good habitat for the species.

Lake Whitefish

Seventy-one lake whitefish were taken. Thirty-two of these were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination.

Table XII. Lake Whitefish from Unnamed Lakes on the Maybelle River (105-5-W4th). Number in Sample: 32

Age Class	n	♀♀	No. Mature	Fork Length (mm) $\bar{x}$	Sx	Range	Weight (g) $\bar{x}$	Sx	Range
VI+	6	1	6	439	± 5.7	415-455	1330	± 55	1120-1460
VII+	6	3	6	461	±10.0	434-495	1507	±104	1245-1875
VIII+	5	3	5	455	±17.7	407-494	1544	±170	980-1920
IX+	10	5	9	483	±10.2	415-525	1820	±109	1090-2270
X+	1	0	1	505			2170		
XI+	1	1	1	519			2320		
XII+	2	1	2	518		510-525	2305		2230-2380
XIII+	1	1	1	523			2530		

The fish in the sample ranged from six to thirteen years in age (Table XII) and all the fish examined were mature. They grow at a good rate until age class VI, but from then on they appear to grow at a slower rate. The fish in age class VI have a mean fork length of 439 mm and a mean weight of 1330 grams. It may be noted that these fish are very variable in weight within each age class.

All thirty-two fish in the sample were examined for plerocercoids of Triaenophorus crassus. Eighteen (56%) were infected with a total of 73 cysts. The total weight of the thirty-two fish was 54.57 kilograms or 120 pounds, which gives a rate of infestation of 61 cysts per 100 pounds of fish. This is too high to put these fish on the commercial market without first filleting them.

It is notable that no younger, smaller fish were caught, as nets were set ranging in size from 2½ to 5½ inches (stretch measure). Only one was caught in the 2½ inch mesh net. Most of the lake whitefish were caught in the 4½ mesh nets, and a fair number were also taken in the 5½ inch mesh nets (Table IX).

The habitat for these fish is probably not ideal, although they were the second most numerous fish caught in the gill nets (Table VIII). The spawning habitat is definitely restricted in most of the lakes due to the large amounts of allochthonous material being carried in by the Maybelle River. Lakes 1 and 6 probably provide the main spawning areas for these fish, and the movement of this species between these lakes is probably quite extensive.

TULLIBEE

Twenty-eight tullibee were taken. Six of these were examined and the fork length, weight, sex, and maturity of each recorded. Scale samples were taken for age determination.

Table XIII. Tullibee from Unnamed Lakes on the Maybelle River (105-5-W4th).
Number in Sample: 6

Age Class	n	♀♀	No. Mature	Fork Length (mm) $\bar{x}$	Fork Length (mm) Range	Weight (g) $\bar{x}$	Weight (g) Range
IV+	2	0	1	242	230-265	200	130-270
V+	2	0	1	275	274-276	370	320-420
VI+	1	1	1	320		460	
VII+	1	0	1	345		640	

These six fish ranged in age from four to seven years. They appear to be maturing during their fourth and fifth years. From the sample, it would seem these fish are quite fast growing (Table XIII) in relation to other tullibee in northern Alberta.

Tullibee do not appear to comprise a very large portion of the standing crop of fish in these lakes. Only 28 were caught in the nets, most of these being caught in the 2½ inch mesh nets. (Table IX). This is probably a result of the small open water areas of the lakes. Spawning areas are restricted to Lakes 1 and 6, the other lakes not containing suitable areas.

These fish probably provide a certain amount of forage for the carnivorous species in this lake, particularly the pike and, to a lesser extent, the walleye.

White Sucker

Eleven white suckers were taken. Most were caught in the 4½ inch mesh nets while some were caught in the 2½ and 3½ inch mesh nets (Table VIII and Table IX). Seven of these fish were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination.

Table XIV. White Suckers from Unnamed Lakes on the Maybelle River (105-5-W4th). Number in Sample: 7

Age Class	n	♀♀	No. Mature	Fork Length (mm) $\bar{x}$	Fork Length (mm) Range	Weight (g) $\bar{x}$	Weight (g) Range
IV+	1	-	0	300		370	
V+	3	1	1	351	318-370	600	420-740
VI+	1	1	1	490		1660	
VII+	1	1	1	457		1300	
VIII+	1	1	1	460		1640	

These fish ranged in age from four to eight years. From this small sample, little can be said about the growth rates. However, it would appear that they grow relatively slowly for white suckers and that beyond age class VI there was very little growth (Table XIV).

The white suckers in these lakes appear to mature during their fifth year and spawn at the beginning of their sixth year. Spawning habitat for the species is found in the delta of the Maybelle River, where it enters this group of lakes.

The species is probably not too numerous in these lakes, as only eleven were caught in the nets (Table VIII). They would have little effect upon other populations of fish.

Longnose Sucker

Four longnose suckers were taken. Three of these came from the $4\frac{1}{2}$ inch mesh nets while one came from the $5\frac{1}{2}$ inch mesh nets. (Table IX). Three of these fish were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination.

Table XV. Longnose Suckers from Unnamed Lakes on the Maybelle River (105-5-W4th). Number in Sample: 3

Age Class	n	♀♀	No. Mature	Fork Length (mm) $\bar{x}$	Fork Length (mm) Range	Weight (g) $\bar{x}$	Weight (g) Range
VIII+	2	1	2	472	470-475	1390	1380-1400
IX+	1	0	1	472		1380	

The three fish belonged to the age classes VIII and IX (Table XV). Little can be determined about these fish except that they are not very numerous in these lakes, only four being caught in the test nets (Table VIII). They would have little or no competitive effect on the populations of other fish in these lakes.

DISCUSSIONS AND CONCLUSIONS

The morphometry of these lakes indicate that they could be quite eutrophic. However, the flushing effect of the Maybelle River on Lakes 2, 3, 4 and 5 tends to lower their productivity. The Maybelle River brings substantial amounts of allochthanous materials into these four lakes, which would tend to further reduce their productivity. The water chemistry indicates only moderate productivity.

The standing crop of bottom fauna was quite low during the survey, indicating that some factors are lowering the productivity of these lakes.

The fish in these lakes have little value for a fishery at the present time. The pike, probably the most numerous fish in the lakes, does not grow to trophy size and the walleye do not appear to be very numerous. The lake whitefish are too heavily infested with _Triaenophorus_ _crassus_ plerocercoids to be of much commercial value. Other species of fish in the lakes have little value, and do not appear to be numerous.

Until this area becomes easily accessible, these lakes have little value for either sport or commercial fisheries.

MAYBELLE RIVER

The Maybelle River rises in Saskatchewan and flows into the Athabasca Delta at Richardson Lake. On May 26, 1967 this river was examined about one mile downstream from the Unnamed Lakes on this river, which were being surveyed at this time.

At this point the mean width of the river was about sixty feet and the mean depth 2½ to 3 feet. The pools were fairly large but infrequent in the stretch of the river examined. The substrate consisted of sand with mud and boulders in the pools and coarse gravel and rubble in the riffle areas. There was no evidence of aquatic vegetation at this date. The stream flow was quite fast and long stretches of white water were noticed.

The immediate shore was heavily vegetated with willows, sedges and grasses. The surrounding country was gently rolling, with sand ridges interspersed with muskeg.

The water temperature at the time of survey was 9.5°C. Rotenone was used to obtain fish, but only one nine-spined stickleback (Pungitius pungitius) was collected. Nets were set on the Unnamed Lakes on this river, with the idea that the nets close to the Maybelle River would catch fish moving up the river. The absence of arctic grayling in these sets is of note.

It is probable that the only fish using this river for movement to any extent are the walleye. If this is the case, its value to a fishery is greatly enhanced.

LAROCQUE LAKE (105-5-W4th)

INTRODUCTION

Larocque Lake was surveyed in the period June 5 to June 10, 1967. This lake is about 120 miles north of Fort McMurray, Alberta and is inaccessible except by float plane during the summer. The lake is situated in Township 105, Range 5, West of the Fourth Meridian. It has no inlet or outlet, a very small drainage area, and the water level appeared to be maintained by ground water.

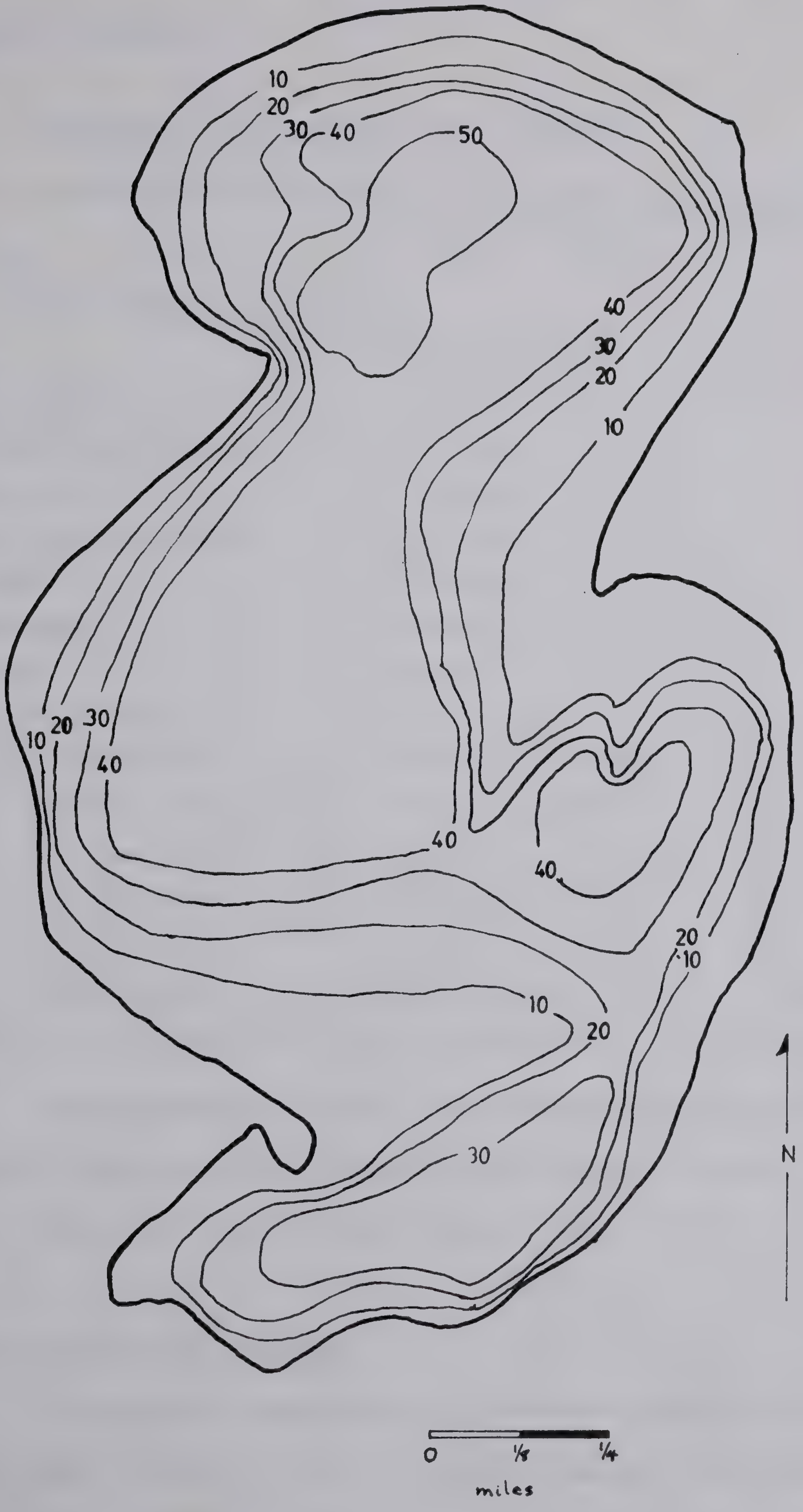
The surrounding country consists of sand ridges interspersed with muskeg. The sand ridges are covered with small jack pine while black spruce grows in much of the muskeg areas.

MORPHOMETRY

Depths were determined using an echo sounder and a contour map was constructed from the data collected (Figure 1). The lake volume was determined from this map, as was the relative depth distribution. Other morphometric data were determined from planimetric maps at a scale of one inch to one mile.

Larocque Lake is quite small, with a surface area of 1.42 square miles (909 acres). The length of the shoreline is 5.9 miles, giving a shoreline development factor of 1.4, which means that this lake has a relatively regular shoreline. The maximum length, in a north-south direction is 2.0 miles, while the maximum effective length is 1.9 miles. The maximum width is 1.1 miles and the mean width is 0.7 miles. The volume is estimated to be in the order of 23,700 acre-feet, giving a mean depth of 26 feet, while the maximum depth found was 52 feet.

Figure 1. Contour map of Larocque Lake.



As can be seen from the depth distribution (Table 1), there is little really shallow area in the lake, the water becoming fairly deep immediately offshore.

Table 1. Morphometry of Larocque Lake (Figure 1)

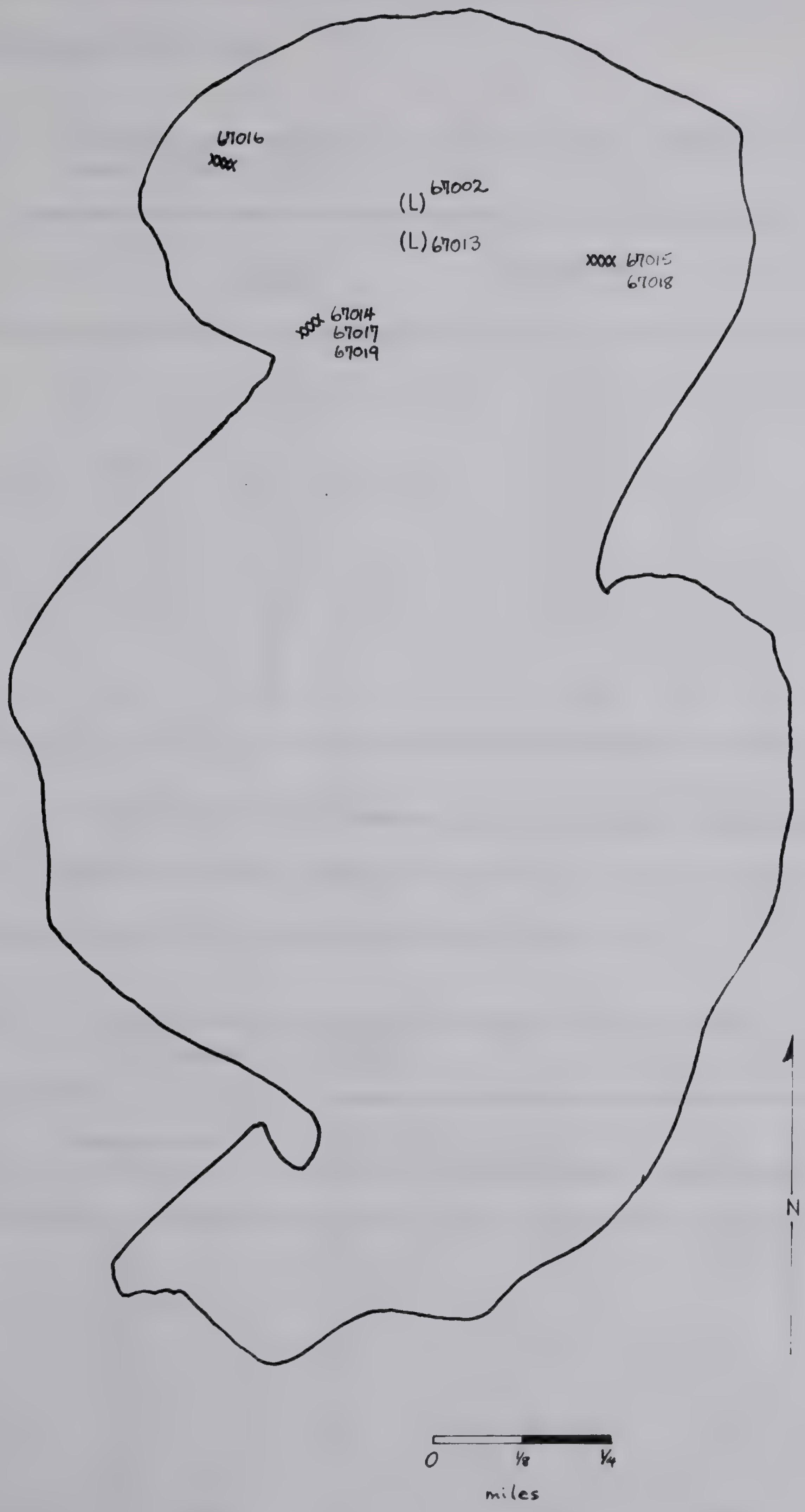
Area:	1.42 square miles (909 acres)	
Shoreline:	5.9 miles	
Shoreline development factor:	1.4	
Volume:	23,700 acre feet	
Maximum length:	2.0 miles	
Maximum effective length:	1.9 miles	
Maximum width:	1.1 miles	
Maximum effective width:	1.1 miles	
Mean width:	0.7 miles	
Maximum depth:	52 feet	
Mean depth:	26 feet	
Depth distribution:		
surface area:	1.42 sq. mi. (909 a.)	
10 feet plus:	1.07 sq. mi. (685 a.)	75% surface area
20 feet plus:	0.86 sq. mi. (550 a.)	61% surface area
30 feet plus:	0.65 sq. mi. (416 a.)	46% surface area
40 feet plus:	0.43 sq. mi. (275 a.)	30% surface area
50 feet plus:	0.05 sq. mi. (32 a.)	4% surface area

The morphometry of this lake indicates that it is quite productive, largely due to its small size, but the limited littoral zone may place some limitations on productivity.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made on June 9, 1967 at station #67002 (Figure 2). At this time the secchi disc visibility

Figure 2. Net sets (xxx) and limnology stations (L) on Larocque Lake.



was 13 feet. The lake beginning to warm up (Table II), and the temperature profile revealed a difference of 5.2°C. from the surface to the bottom at 52 feet.

Table II. Observations taken at Limnology Station #67002 on Larocque Lake, June 9, 1967.

Depth (feet)	Temperature (°C.)
0	9.7
5	9.7
10	8.9
15	8.7
20	8.6
25	8.5
30	8.4
35	8.2
40	8.0
45	7.5
50	6.7
52	4.5

A second series of observations was made on Larocque Lake on August 19, 1967 at station #67013 (Figure 2). At this time, thermal and chemical stratification were evident (Table III).

Table III. Observations taken at Limnology Station #67013 on Larocque Lake, August 19, 1967.

Depth (feet)	Temperature (°C.)	Dissolved oxygen		pH (Hellige)	Conductance (mmhos/cm)
		p.p.m.	% saturation		
0	19	8	85	7.6+	110
5	18.5				
10	18.5				
15	18				
20	18				
25	17.5				
30	17.5	9	90		111
35	17				
40	13				
45	11	0	0	6.8	115
50	10				

At this time, a thermocline was well defined, located between 35 and 40 feet. Below this level there was severe oxygen depletion, as no oxygen could be detected using the Hach method. The pH in the hypolimnion was far more acidic than at the surface. This could be caused by decomposition occurring on the bottom.

Two water samples were taken at the limnology station on August 19, 1967 and analyzed with a Hach kit, except for pH, which was determined with a Hellige color comparator, and the conductivity, which was determined with a conductivity meter.

Table IV. Water Chemistry, Larocque Lake. The Samples were taken at the Limnology Station #67013 on August 19, 1967.

Sample Number	67057	67058
Depth (feet)	0	45
Temperature (^{o}C.)	19	11
Dissolved oxygen (p.p.m.)	8	0
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0
Total alkalinity (p.p.m. $CaCO_3$)	75	75
Calcium hardness (p.p.m. $CaCO_3$)	50	35
Total hardness (p.p.m. $CaCO_3$)	55	65
Chlorides (p.p.m.)	5	5
pH (Hellige)	7.6+	6.8
Conductance (mmhos/cm)	110	115

The limnology and water chemistry indicate a relatively high productivity in this lake, and that the lake is definitely eutrophic. The conductivity of the water is relatively high for lakes in northern Alberta and indicates a substantial amount of dissolved nutrients in the water. The oxygen depletion in the hypolimnion, severe as it is, indicates a rapid turnover of nutrients in this lake.

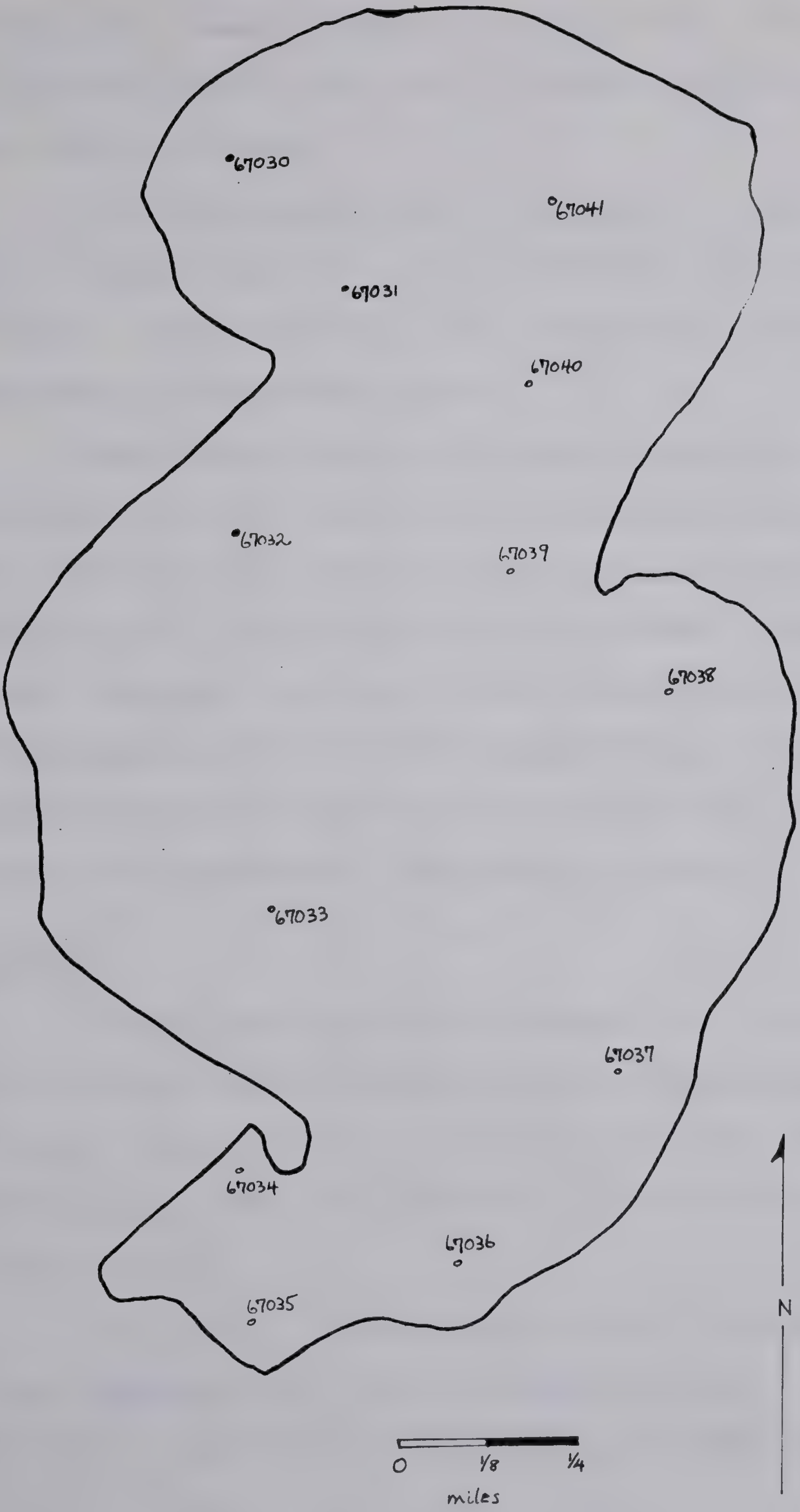
BOTTOM FAUNA

Twelve bottom samples were taken on Larocque Lake between June 5 and June 10, 1967. Each sample consisted of four hauls with a six inch square Ekman dredge, which was washed through a screen bottomed bucket (25 meshes per inch) and all living organisms preserved. These were divided into major groups, counted and their displaced volumes measured in the laboratory (Figure 3, Table V).

Table V. Bottom Fauna from Larocque Lake. The Samples were taken between June 5 and June 10, 1967.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Hirudinea	Amphipoda	Trichoptera	Chironomidae	Gastropoda	Pelecypoda	Others	Total	Displaced Volume (cc)
67030	21	Muck	-	-	1	-	20	-	-	-	21	0.10
67031	48	Muck	-	-	-	-	6	-	-	-	6	0.10
67032	22	Sand	25	-	15	1	95	9	8	5	158	0.30
67033	44	Muck	5	-	-	-	12	-	-	-	17	0.15
67034	7	Sand	1	3	-	-	175	4	4	13	200	0.50
67035	27	Muck	2	-	-	-	26	-	-	-	28	0.40
67036	34	Muck	-	-	-	-	103	-	-	-	103	1.20
67037	8	Sand	3	2	-	2	112	-	-	40	159	0.40
67038	38	Muck	-	1	-	-	21	-	-	-	22	0.25
67039	6	Sand	14	1	30	8	310	-	-	-	363	0.80
67040	36	Sand	3	-	-	-	37	-	-	-	40	0.65
67041	50	Muck	-	-	-	-	3	-	-	-	3	0.05
Average/square meter			48	6	41	10	825	12	11	52	1005	4.40
Percent of total no.			5	1	4	1	82	1	1	5		

Figure 3. Bottom sampling stations on Larocque Lake.



From the bottom samples, it can be seen that the bottom consists of sand or organic muck. The sand predominates at the shallower depths, even being found as deep as 36 feet. The shoreline was completely sandy and there was no evidence of aquatic vegetation at the time of the survey.

The average standing crop of bottom organisms was found to be 1005 per square meter with a volume displacement of 4.40 cc per square meter. This is not very great, and may place limitations on a population of bottom feeding fishes.

The Chironomidae dominated the bottom fauna at all depths, being found in all samples and comprising 82% of the total number of bottom organisms in the samples. Oligochaetes were the next most abundant organisms, comprising 5% of the total number in the samples (Table V). Nematodes made up the largest portion of the remainder but contributed very little to the displaced volume, so that this group was not considered significant in the bottom fauna. All other organisms were insignificant in both number and volume.

FISH FAUNA

Test nets were set six times between June 8 and June 10, 1967. All sets (with one exception) were 200 yards in length, consisting of 50 yards of each of 2½, 3½, 4½ and 5½ inch mesh nets. The one exception was set #67016 which consisted of only 50 yards of 1½ inch mesh net (Figure 3).

The fish caught included lake whitefish (*Coregonus clupeaformis*), tullibee (*Coregonus artedi*) and perch (*Perca flavescens*). From the test results it would appear that tullibee are the most abundant species

Lake Whitefish

One hundred and eleven lake whitefish were caught in gill nets. Fifty-seven of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination (Table VIII).

Table VIII. Lake Whitefish from Larocque Lake. Number in Sample: 57

Age Class	n	♀♀	No. Mature	Fork Length (mm)			Weight (g)		
				x̄	Sx	Range	x̄	Sx	Range
IV+	3	2	3	320		320-321	400		380-420
V+	14	4	14	344	±5.2	308-377	463	±20	340-660
VI+	12	6	12	358	±9.9	310-425	530	±41	330-810
VII+	18	7	17	394	±7.5	334-483	632	±27	440-840
VIII+	6	1	6	418	±7.5	402-450	672	±42	500-760
IX+	3	2	3	432		425-440	827		800-880
X+	1	0	1	444			880		

The fish in the sample ranged in age from four to ten years. Even the fish in age class IV were mature, indicating that these fish mature early. However, they do not have a very good growth rate, as can be seen in Table VIII. Fish in age class V had a mean fork length of 344 mm and a mean weight of 463 grams, which does not represent very much increase for a three year period.

This slow growth rate may be a reflection of the poor quantities of bottom organisms. These fish have a fair growth rate until they reach age class IV, and they may be feeding on plankton during the earlier years of their life. The spawning habitat for this species is more than adequate and a condition of overpopulation resulting in small, stunted fish is evident.

Thirty of these fish were examined for plerocercoids of *Triaenophorus crassus*, and none were found. This is not surprising, as no pike were caught in the nets, and they are probably not present in this lake. The pike is the final host of the psuedophyllidean cestode, *Triaenophorus crassus*.

As a result of the absence of the pike-whitefish tapeworm in these whitefish they have a fair market value, and harvesting this population could bring about an increase in growth rates.

Tullibee

Two hundred and seventy-one tullibee were caught in the 1½ inch mesh net on June 9, 1967. Thirty of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination (Table IX).

Table IX. Tullibee from Larocque Lake, June 9, 1967
Number in Sample : 30

Age Class	n	OO XX	Fork Length (mm) $\bar{x}$	$S_{\bar{x}}$	Range	Weight (g) $\bar{x}$	$S_{\bar{x}}$	Range
II+	1	0	93			65		
III+	28	10	185	±1.4	167-195	64	±2.0	40-80
IV+	1	0	206			100		

Most of the tullibee in the sample were in age class III, and all the tullibee caught were mature, the youngest being in age class II. These small tullibee (the largest one weighed 100 g.) are early maturing and are probably the most numerous fish in the lake. They are so small as to be of little value for a commercial fishery, and they constitute a dead end in productivity in this lake, as there is no large population of carnivorous fish to utlize them as a forage fish.

DISCUSSION AND CONCLUSIONS

The morphometry of Larocque Lake indicates that it is eutrophic and this is born out by the limnological observations, as oxygen depletion in the hypolimnion was severe by August 19.

The bottom fauna did not appear to be very abundant, and this may place limitations on the populations of bottom feeding fish, such as lake whitefish. This may be part of the reason for the slow growth rate of this species of fish in Larocque Lake.

Only two species of fish were found in any abundance in this lake, the lake whitefish and tullibee. Of these, the tullibee are too small to be of any value, while the lake whitefish, although small, are not infested with the pike-whitefish tapeworm and have a value for a commercial fishery.

Using a morpho-edaphic index (Ryder, 1965), a total annual production of close to 5 pounds per acre is postulated. Probably 2 pounds per acre of this could be realized as a harvest of lake whitefish. This would mean an annual harvest of close to 2,000 pounds.

Until this area becomes more easily accessible, it is not likely that a harvest of these fish would prove profitable. Once the fish are harvested, there will probably be an increase in growth rates of the lake whitefish and they should increase in size, which would make them more valuable.

BARBER LAKE (105-6-W4th)

INTRODUCTION

Barber Lake is located about 120 miles north of Fort McMurray, Alberta and is accessible only by float plane during the summer months. Barber Lake was surveyed between June 10 and June 14, 1967. This lake is situated in Township 105, Range 6, West of the Fourth Meridian. The surrounding area consists of sand ridges interspersed with muskeg, with small jack pine growing on the sand ridges and black spruce in the muskeg.

Barber Lake is quite small, about one square mile in area, and has no inlets or outlets. Since it has a very small drainage basin, the water level must be maintained by ground water.

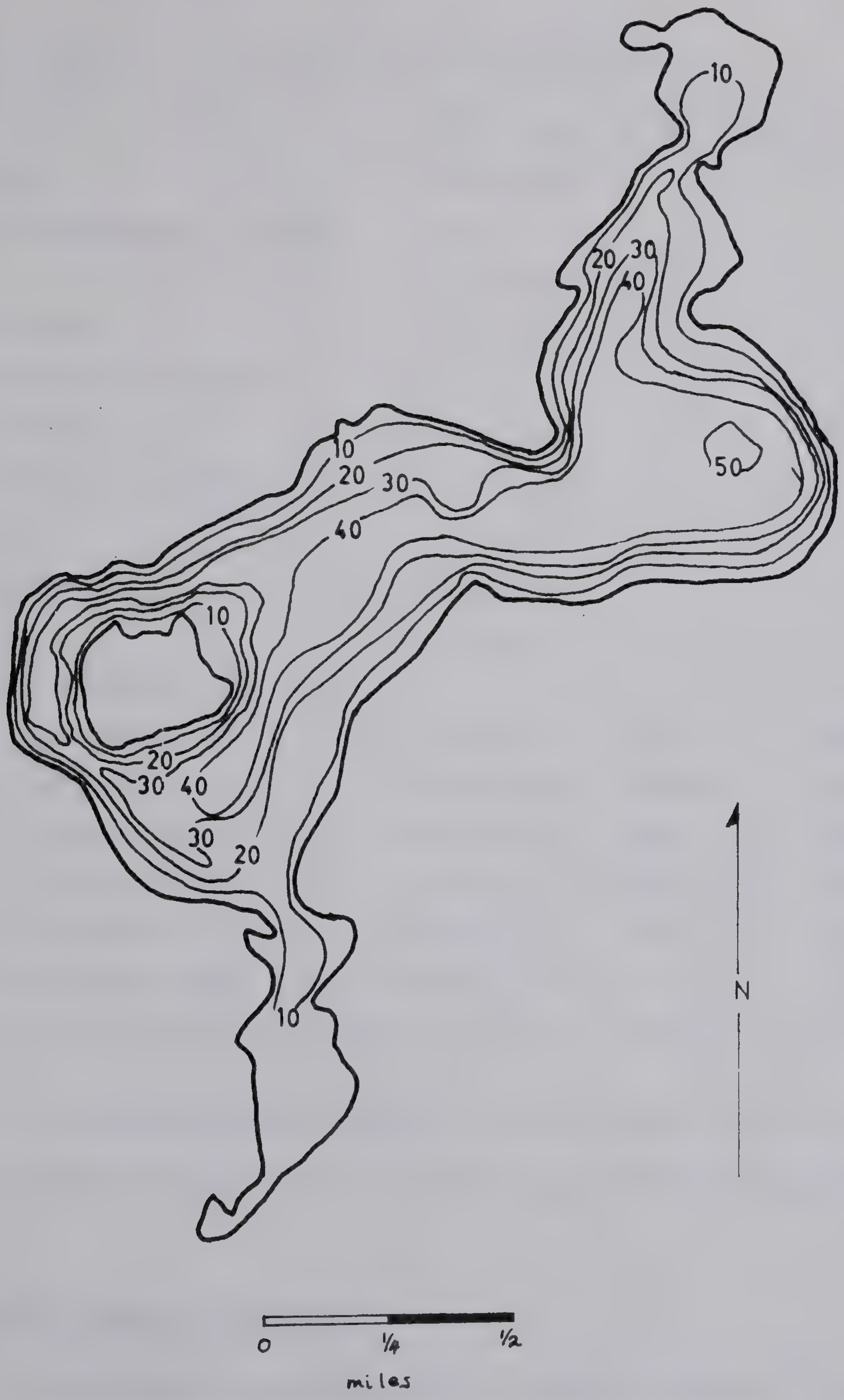
MORPHOMETRY

Barber Lake has a surface area of 1.03 square miles or 659 acres. The length of the shoreline (including the shoreline of the one island) is 8.6 miles, giving a shoreline development factor (the ratio of the actual shoreline to the shortest length that would enclose the same area) of 2.2 (Table I).

Depths were determined using an echo sounder and a contour map was constructed from the data collected (Figure I). Water volume and depth distribution were determined from this map. The volume is estimated to be in the order of 15,000 acre-feet, giving a mean depth of 23 feet, while the maximum depth found was 52 feet.

The maximum length of Barber Lake is 2.6 miles while the maximum effective length was only 1.6 miles. The maximum width was 0.7 miles, while the maximum effective width was 0.5 miles and the mean width 0.4 miles.

Figure 1. Contour map of Barber Lake.



As can be seen from the depth distribution, the lake bottom drops off quite rapidly from shore to below 10 feet, but only 37% of the lake is deeper than 30 feet.

Table I. Morphometry of Barber Lake (105-6-W4th).

Area:	1.03 square miles (659 acres)	
Shoreline:	8.6 miles	
Shoreline development factor:	2.2	
Volume:	15,000 acre feet	
Maximum length:	2.6 miles	
Maximum effective length:	1.6 miles	
Maximum width:	0.7 miles	
Maximum effective width:	0.5 miles	
Mean width:	0.4 miles	
Maximum depth:	52 feet	
Mean depth:	23 feet	
Depth distribution:		
surface area:	1.03 sq. mi. (659 a.)	100% surface area
10 feet plus:	0.77 sq. mi. (493 a.)	75% surface area
20 feet plus:	0.54 sq. mi. (345 a.)	52% surface area
30 feet plus:	0.38 sq. mi. (243 a.)	37% surface area
40 feet plus:	0.22 sq. mi. (141 a.)	21% surface area
50 feet plus:	0.01 sq. mi. (6 a.)	1% surface area

The morphometry of Barber Lake indicates that it is eutrophic, and barring any adverse factors, should have a high productivity.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made on Barber Lake on August 19, 1967 at 11:30 a.m. (Figure 2). At this time, the transparency of the water, as measured with a secchi disc, was 21 feet. Stable thermal stratification was evident, the thermocline lying at a depth of approximately 35 feet (Table II).

Table II. Limnological Observations made at Barber Lake, August 19, 1967.

Depth (feet)	Temperature (°C.)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)	Conductance (mmhos/cm)
0	19	11	100	7.4	58
5	19				
10	18.5				
15	18.5				
20	18				
25	18				
30	17.5	8	85		59
35	14				
40	11.5	2.8	30	6.6	57
50	8.5				

Dissolved oxygen values were high in the epilimnion, but there was some oxygen depletion in the hypolimnion, which was probably more severe closer to the bottom. The pH, as measured with a Hellige comparator (using Bromthymol Blue-D) was alkaline at the surface (7.4), but there was a significant difference at the 40 feet level, where the pH was 6.6. This probably indicates a substantial rate of decomposition occuring on the bottom of this lake. The limnology of this lake indicates a fair degree of productivity.

Two water samples were taken at the limnology station on Barber Lake on August 19, 1967. All determinations were made with a Hach chemical kit, except for pH which was made with a Hellige comparator, and conductance which was measured with a Beckman conductivity meter.

Figure 2. Net sets (xxx) and limnology station (L) on Barber Lake.

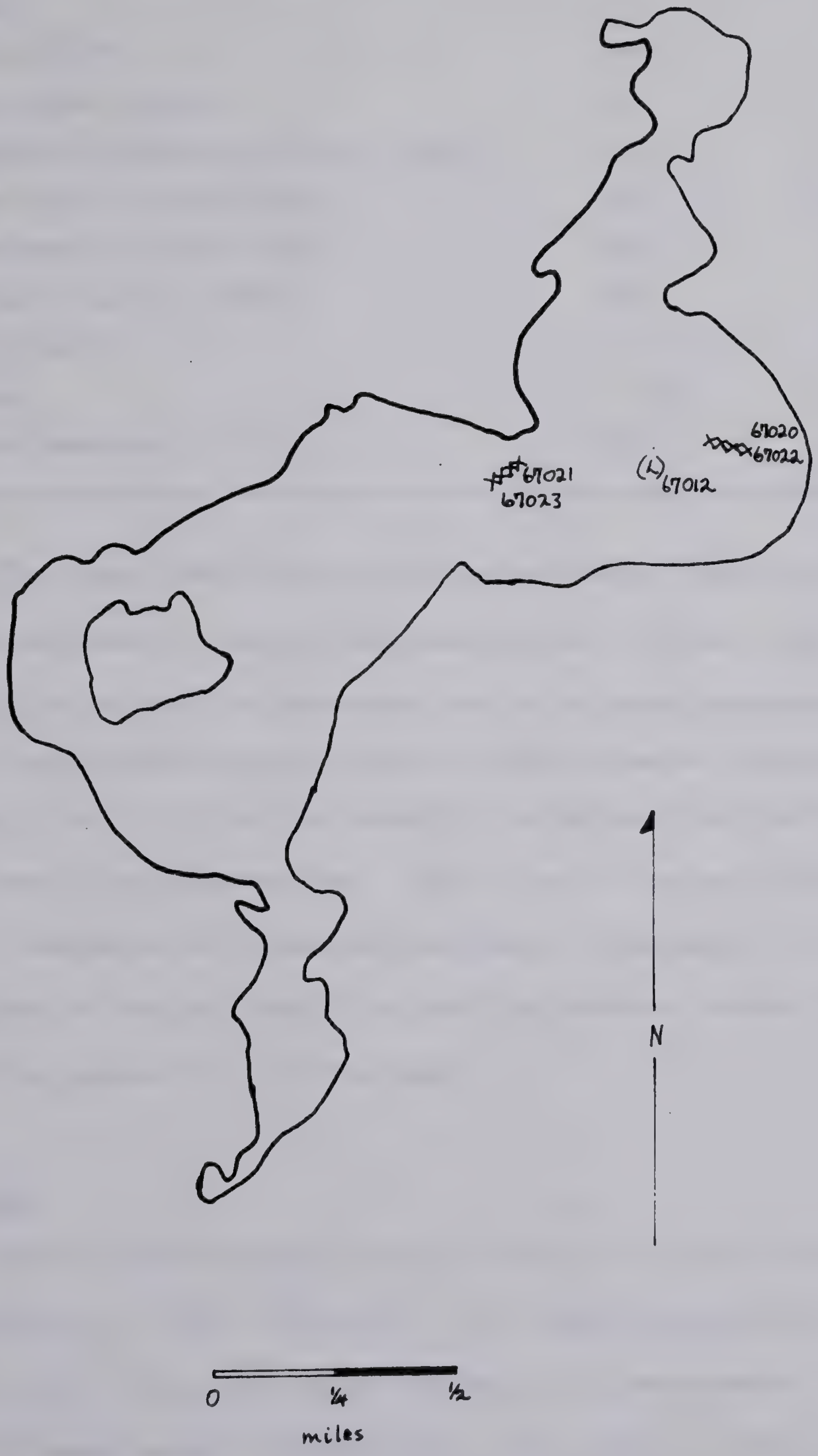


Table III. Water Chemistry, Barber Lake.

Sample Number	67055	67056
Depth (feet)	0	40
Temperature (°C.)	19	11.5
Dissolved oxygen (p.p.m.)	11	2.8
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0
Total alkalinity (p.p.m. $CaCO_3$)	30	40
Calcium hardness (p.p.m. $CaCO_3$)	20	25
Total hardness (p.p.m. $CaCO_3$)	30	30
Chlorides (p.p.m.)	5	10
pH (Hellige)	7.4	6.6
Conductance (mmhos/cm @ 18°C.)	58	57

The total alkalinity was quite low, being from 30 to 40 p.p.m. as calcium carbonate. The calcium hardness was also low, being from 20 to 25 p.p.m. as calcium carbonate, while the total hardness was 30 p.p.m. as calcium hardness. The chlorides, however, were quite high, being 5 to 10 p.p.m. The specific conductance (standardized to 18°C.) was 57 and 58 mmhos/cm. This is quite low, and indicates a relatively low amount of dissolved nutrients in the water. This is substantiated by the low alkalinity and low hardness values. This may limit the productivity of the lake.

BOTTOM FAUNA

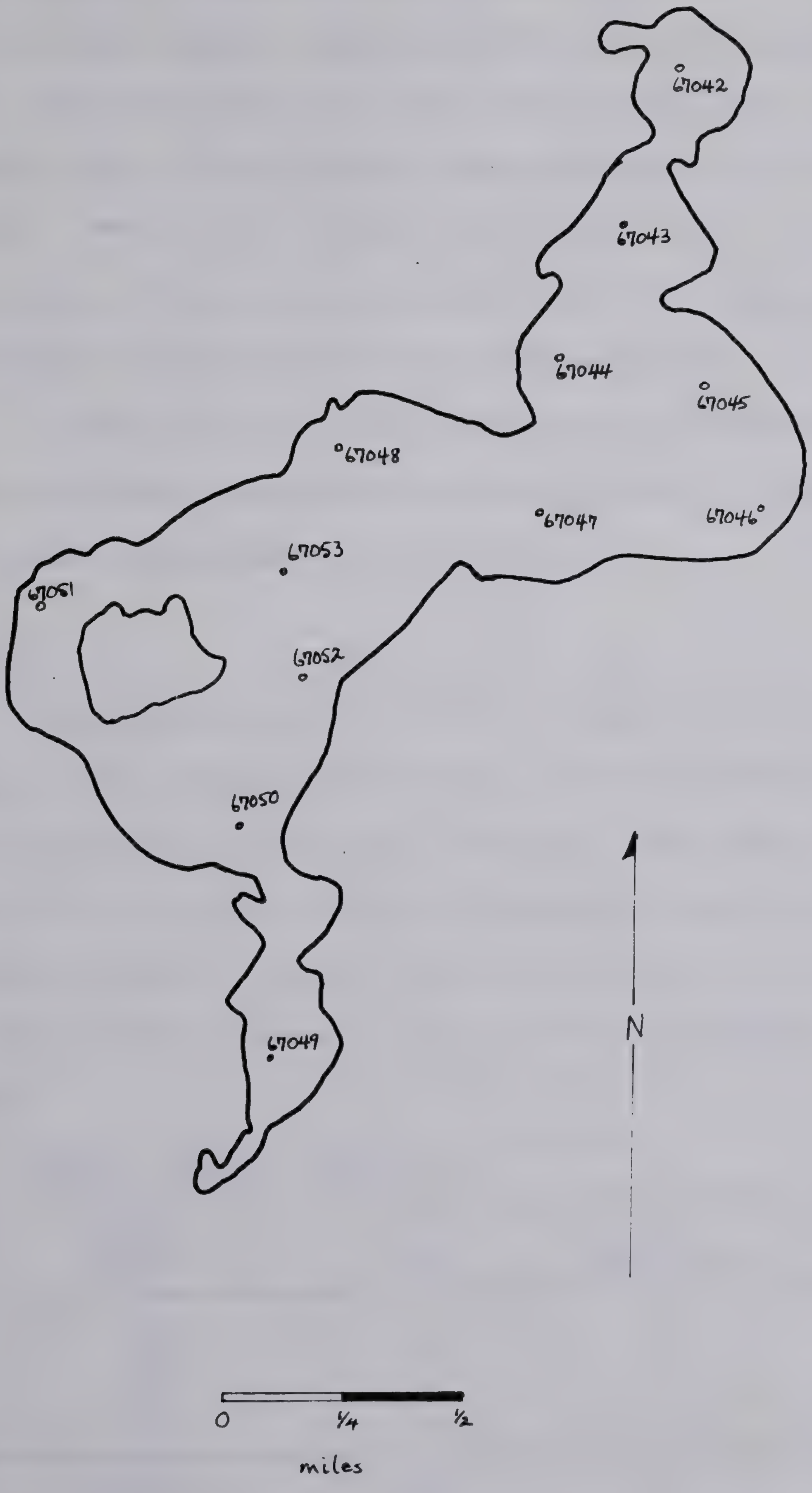
Twelve bottom samples were collected from Barber Lake between June 10 and June 14, 1967 (Figure 3). Each sample consisted of four hauls with a six inch square Ekman dredge, which were washed through a screen-bottomed bucket (25 meshes per inch) and all living organisms preserved. These were classified according to major groups, counted and their displaced volume measured later in the laboratory (Table IV).

Table IV. Bottom Fauna from Barber Lake.

Sample No.	Depth (feet)	Substrate									Total	Displaced Volume (cc)
67042	12	Muck	-	7	-	-	-	-	-	-	7	0.05
67043	25	Sand	-	23	2	-	25	-	-	3	53	0.15
67044	14	Sand	30	110	7	2	28	-	-	20	197	0.90
67045	24	Sand	2	40	-	-	80	-	4	100	226	0.45
67046	46	Muck	5	-	-	-	3	12	-	-	20	0.10
67047	36	Muck	-	-	-	-	3	5	1	-	9	0.10
67048	14	Sand	5	53	53	-	28	-	-	20	159	0.45
67049	9	Muck	-	-	-	-	2	-	-	-	2	0.05
67050	11	Sand	10	85	18	1	51	-	-	20	185	0.50
67051	38	Muck	5	8	-	-	10	3	-	-	26	0.20
67052	4	Sand	7	150	53	-	26	-	-	1	237	0.55
67053	48	Muck	25	-	-	-	26	16	-	-	67	0.25
Average/square meter			80	427	119	3	253	32	4	146	1066	3.36
Percent of total no.			8	40	11	-	24	3	-	14		

From the bottom samples it can be seen that sand is found at depths up to 25 feet, although organic muck was found as shallow as 9 feet. The shoreline was completely sandy, with no mud evident at all. There was very little evidence at the time of the survey of any extensive growth of aquatic plants, which would probably tend to lower the amount of fish food organisms in the lake.

Figure 3. Bottom sampling stations on Barber Lake.



An average of 1066 bottom organism per square meter was found, with a displaced volume of 3.36 cc per square meter. This is a low standing crop of bottom organisms and may place some limitation on bottom feeding fish species, such as lake whitefish.

The most abundant organisms in the bottom fauna were amphipods, comprising 40% of the total number of organisms. The next most abundant were the chironomidae, comprising 24% of the total number of organisms. Most of the remaining organisms were small nematodes and contributed very little to the displaced volume. All other organisms were relatively insignificant both in number and volume.

In conclusion it may be said that the bottom fauna is quite poor, which may place limitations on the productivity of bottom feeding fishes, such as lake whitefish, in this lake.

FISH FAUNA

Test gangs were set four times from June 10 to 14, 1967. Each gang was 200 yards in length and consisted of 50 yards of each of 2½, 3½, 4½ and 5½ inch mesh nets (Figure 2). Fish caught included pike (Esox lucius) and lake whitefish (Coregonus clupeaformis)(Table V). No tullibee were caught, but no 1½ inch mesh nets were set, and there may be small tullibee in the lake, which would not be caught in the test gangs.

Table V. Test Net Results, Barber Lake.

Net Set No.	Depth (feet)	Pike	Lake Whitefish	Total
67020	45	1	24	25
67021	35	1	14	15
67022	45	3	15	18
67023	35	3	8	11
	Totals	8	61	69

It may be noted that very few pike were caught in the test gangs. The habitat for pike in this lake is quite restricted, as most of the shallow areas are very sandy and have very little or no rooted aquatic vegetation. The population of pike in Barber Lake is probably quite small. Most of the pike caught, both in the nets and by angling, were very small and had a very thin appearance.

Table VI. Summary of Test Net Results, Barber Lake, by Mesh Size.

Fish species	Mesh size (ins) 2½	3½	4½	5½
Pike	5	2	0	1
Lake whitefish	0	2	36	23
Totals	5	4	36	24

Most of the pike were caught in 2½ inch mesh net, which is indicative of their small size. The lake whitefish, on the other hand, were caught mostly in the 4½ and 5½ inch mesh nets (Table VI). These fish appear to be quite numerous, and are perhaps the most numerous fish in the lake.

Lake Whitefish

Sixty-one lake whitefish were caught in gill nets between June 10 and 14, 1967. Fifty-two of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination (Table VII).

Table VII. Lake Whitefish from Barber Lake.
Number in Sample: 52

Age			No.	Fork Length (mm)			Weight (g)		
Class	n	♀♀	Mature	$\bar{x}$	Sx	Range	$\bar{x}$	Sx	Range
V+	2	1	1	414		411-418	960		920-1000
VI+	11	3	11	455	±6.1	426-485	1325	±32	1155-1480
VII+	17	8	17	480	±4.7	433-510	1527	±46	1200-1935
VIII+	15	9	15	501	±4.3	474-525	1655	±45	1450-1975
IX+	6	4	6	507	±5.7	482-521	1854	±76	1580-2145
XII+	1	0	1	523			2260		

The lake whitefish in the sample ranged from five to twelve years in age, although most were in the age classes VI, VII, and VIII. All the fish examined were mature (Table VII). These fish appear to have a good growth rate, even in their later years, and there does not appear to be a great deal of variation in sizes within the different age classes.

The spawning habitat for these fish appears to be more than adequate. There may be some limitation on this species as a result of the poor production of bottom organisms, which this species feeds on.

Thirty-five of these fish were examined for plerocercoids of Triaenophorus crassus. Thirty-two (91%) were infested with a total of 333 cysts. The total weight of the fish examined was 53.75 kilograms (118 pounds), which gives a rate of infestation of 282 cysts per 100 pounds of fish. This is too high for these fish to be of much commercial value.

DISCUSSION AND CONCLUSIONS

Most of the fish production in Barber Lake could be realized as lake whitefish. Using a morpho-edaphic index (Ryder, 1965) an estimate of 3 pounds per acre, or a total of about 2000 pounds of fish per year could be harvested. About 1300 pounds could be harvested as lake whitefish, but these are so heavily infested with plerocercoids of the pike-whitefish tapeworm as to be of little value on the commercial market. As a result of this, the lake has little value as either a sport fishery (due to the poor population of pike) or a commercial fishery.

UNNAMED LAKE ON KEANE CREEK (106-3-W4th; 106-4-W4th)

INTRODUCTION

This lake is situated about 125 miles north of Fort McMurray, Alberta. It lies in parts of Township 106, Range 3, West of the Fourth Meridian and Township 106, Range 4, West of the Fourth Meridian. It is inaccessible except by float plane during the summer months. The lake is unnamed, and forms the headwaters of Keane Creek, which drains into Lake Athabasca. The lake was surveyed between June 14 and June 18, 1967.

The surrounding area consists of sand dunes interspersed with areas of muskeg. Small jack pine grow on the sand ridges with black spruce in the muskegs.

MORPHOMETRY

Depths were determined using an echo sounder. All other information concerning morphometry was taken from planimetric maps at a scale of one inch to one mile (Figure 1).

The lake has an area of 1.93 square miles, or 1235 acres. The length of the shoreline (including 10 islands) is 17 miles, which gives a shoreline development factor of 3.4, which means the shoreline is quite irregular. The maximum depth found was 10 feet and the mean depth was estimated to be 5 feet, which gives a volume in the order of 6,000 acre feet (Table I). The maximum length of the lake is 3.8 miles, while the maximum effective length is 2.3 miles. The maximum width is 1.3 miles while the maximum effective width is 0.7 miles while the mean width is 0.5 miles.

Figure 1. Net sets on Unnamed Lake on Keane Creek.

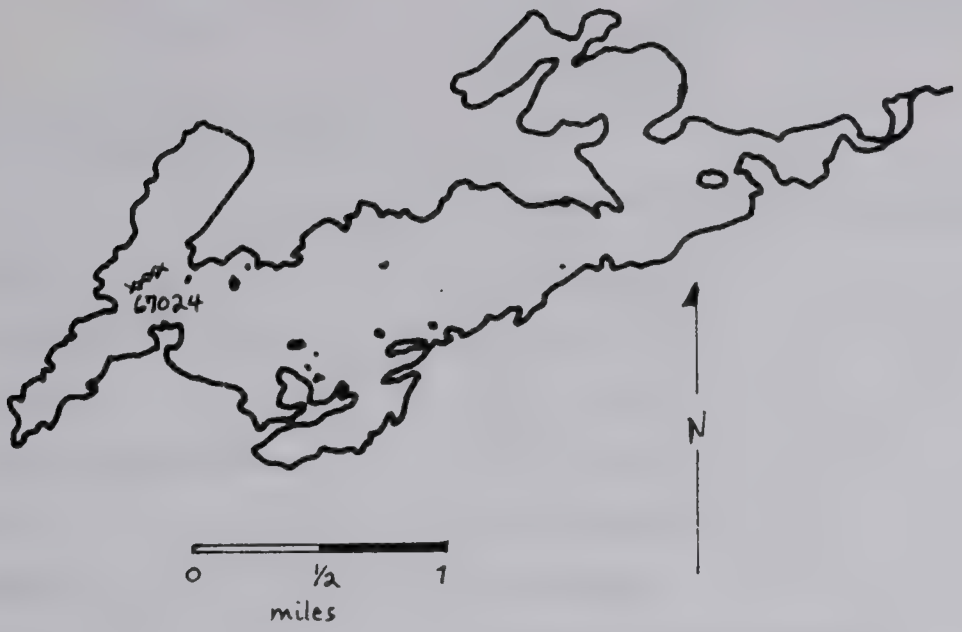


Figure 2. Bottom sampling stations on Unnamed Lake on Keane Creek.

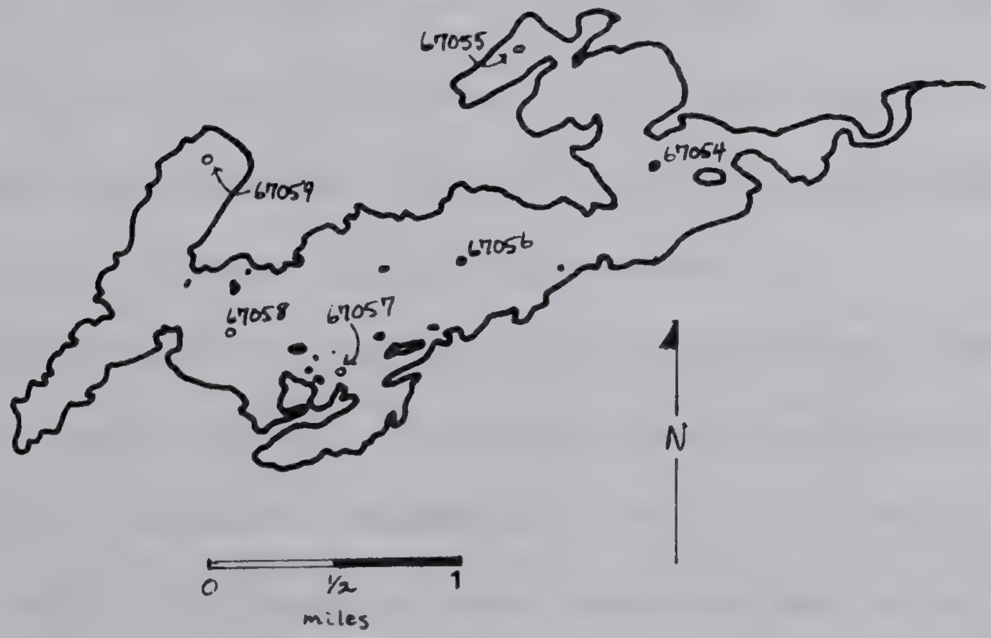


Table I. Morphometry of Unnamed Lake on Keane Creek (106-3-W4th; 106-4-W4th)

Area:	1.93 square miles (1235 acres)
Shoreline:	17.0 miles
Shoreline development factor:	3.4
Volume	6,000 acre feet (estimated)
Maximum length:	3.8 miles
Maximum effective length:	2.3 miles
Maximum width:	1.3 miles
Maximum effective width:	0.7 miles
Mean width:	0.5 miles
Maximum depth:	10 feet
Mean depth:	5 feet (estimated)

The morphometry of this lake indicates that it is eutrophic, to the point that it may limit the species and abundance of fish present in the lake.

BOTTOM FAUNA

Six bottom samples were taken between June 14 and June 18, 1967 (Figure 2). Each sample consisted of four hauls with a six inch square Ekman dredge and was washed through a screen bottomed bucket (25 meshes per inch) and all living organisms preserved.

From the bottom samples, it can be seen that the bottom consisted of organic ooze. This organic ooze was quite flocculent, and appeared to be poorly decomposed. Most of the shoreline, however, was sandy, with a few areas of rocky shore and mud being found at the east end of the lake where Keane Creek drains from it. Evidence of rooted aquatic vegetation was found throughout most of the lake, and in late summer probably this vegetation predominated throughout the lake.

Table II. Bottom Fauna from Unnamed Lake on Keane Creek.

Sample No.	Depth (feet)	Substrate	Amphipoda	Odonata	Chironomidae	Total	Volume (cc)
67054	5	Organic ooze	-	-	1	1	0.01
67055	4	Organic ooze	-	-	-	0	0
67056	8	Organic ooze	1	-	-	1	0.01
67057	7	Organic ooze	1	1	-	2	0.25
67058	9	Organic ooze	-	-	-	0	0
67059	6	Organic ooze	1	-	-	1	0.01
Average/square meter			5	2	2	9	0.50
Percent of total no.			60	20	20		

An average of 9 organisms per square meter was found, with a displaced volume of 0.50 cc per square meter (Table II). Three groups of organisms were found in the six samples: amphipods, dragonfly nymphs and chironomid larvae. The bottom fauna appears to be very poor from this sampling, although the fauna associated with the aquatic plants probably provides a fair number of fish food organisms.

FISH FAUNA

A test gang, consisting of 50 yards of each of 2½, 3½, 4½ and 5½ inch mesh nets was set on June 15 and lifted on June 16, 1967 (Figure 2). The fish caught included pike (*Esox lucius*) and white suckers (*Catostomus commersoni*). No lake whitefish or tullibee were caught in the nets and it is probable that they are not present in this lake, as a result of its very shallow depth.

Table III. Test Net Results, Unnamed Lake on Keane Creek.

Mesh size (ins.)	Depth (feet)	Pike	White suckers	Total
2½	5	23	-	23
3½	6	2	8	10
4½	7	-	15	15
5½	7	-	1	1
	TOTALS	25	24	49

Pike

Twenty-five pike were caught in gill nets on June 16, 1967, all but two being taken in the 2½ inch mesh net (Table III). Twenty-four of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination (Table IV).

Table IV. Pike from Unnamed Lake on Keane Creek, June 16, 1967.
Number in Sample: 24. All were mature.

Age Class	n	♀♀	Fork length (mm) $\bar{x}$	$S_{\bar{x}}$	Range	Weight (g) $\bar{x}$	$S_{\bar{x}}$	Range
IV+	1	1	449			580		
V+	9	5	495	±5.9	477-524	709	±24	590-800
VI+	13	5	521	±5.5	485-555	805	±24	650-920
VII+	1	0	555			1190		

The pike from this lake are quite small and appear to have a slow growth rate, as fish in age class VI were only 521 mm in length and weighted an average of 805 grams. They also have a rather thin appearance. The poor growth rate is probably due to a poor food supply and overpopulation.

White Suckers

Twenty-four white suckers were caught in gill nets on June 16, 1967, most being caught in the 4½ inch mesh net (Table III). All were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination (Table V).

Table V. White Suckers from Unnamed Lake on Keane Creek, June 16, 1967. Number in Sample: 24. All were mature.

Age Class	n	♀♀	Fork length (mm) $\bar{x}$	$S\bar{x}$	Range	Weight (g) $\bar{x}$	$S\bar{x}$	Range
III+	3	1	404		375-431	955		775-1140
IV+	14	5	444	±5.8	415-490	1214	±49	1000-1600
V+	6	5	500	±9.9	463-521	1580	±70	1360-1820
VI+	1	1	540			1960		

The white suckers from this lake reach a good size, and would appear to grow well (Table V). At age IV they have an average fork length of 444 mm and an average weight of 1214 grams. All the fish caught were mature, even those in age class III.

DISCUSSION AND CONCLUSIONS

The morphometry of this lake indicates that it is eutrophic, so much so that it places limitations on the species of fish and the numbers that will inhabit the lake. The only fish caught were pike and white suckers, neither species being of much commercial value, and the pike being too small to be of much value for a sport fishery.

The bottom fauna appears to be very poor, and the numbers of fish in the lake may be limited by this. However, in a lake which is so shallow, a long period of ice cover must have very severe effects on the populations of fish, particularly at this northern latitude.

This lake has little value as a sport or commercial fishery, but in the future, it may have some value for producing animal food, particularly after this area becomes easily accessible.

KEANE CREEK

The headwaters of Keane Creek were examined on June 17, 1967 at the time when the Unnamed Lake on Keane Creek was being surveyed. The stream as it left the lake was about 15 feet wide and 2 to 3 feet deep. It was very slow moving and had a mud and detribtus bottom.

The banks consisted of a type of 'floating bog'. Beaver had dammed up the stream in various places. The water temperature at this time was 18°C.

The surrounding country was gently rolling, with sand ridges covered with small jack pine, interspersed with muskeg.

Rotenone was used to obtain fish in the stream at this time. Fish caught included pike (Esox lucius), burbot (lota lota), white suckers (Catostomus commersoni), perch (Perca flavescens) and nine-spined sticklebacks (Pungitius pungitius).

UNNAMED LAKES ON CROWN CREEK (107-3-W4th)

INTRODUCTION

Four small lakes on Crown Creek were surveyed between June 18 and June 25, 1967. These small lakes are about 130 miles north of Fort McMurray, Alberta, and are inaccessible except by float plane during the summer. All four lakes are located in Township 107, Range 3, West of the Fourth Meridian. Crown Creek, which drains these lakes, flows into Lake Athabasca.

The surrounding country consists of sand ridges interspersed with muskeg. The sand ridges are covered with small jack pine while much of the muskeg supports black spruce.

MORPHOMETRY

Depths were determined on the four lakes using an echo sounder, and contour maps were constructed from the data collected (Figure 1), from which lake volumes were determined. Other morphometric data were obtained from planimetric maps at a scale of one inch to one mile. For the purposes of this survey, the lakes have been numbered from one to four (Figure 1).

All the lakes are quite small, ranging in size from 58 to 435 acres. The shoreline development factors ranged from 1.2 to 2.8, although they were over 2 in three of the lakes, indicating that the shorelines were generally irregular.

The maximum depths in the four lakes ranged from 28 to 58 feet, while the mean depths ranged from 8 to 20 feet. Three of these lakes are deep enough for thermal stratification to occur (Table 1).

Figure 1. Contour map of Lakes on Crown Creek.

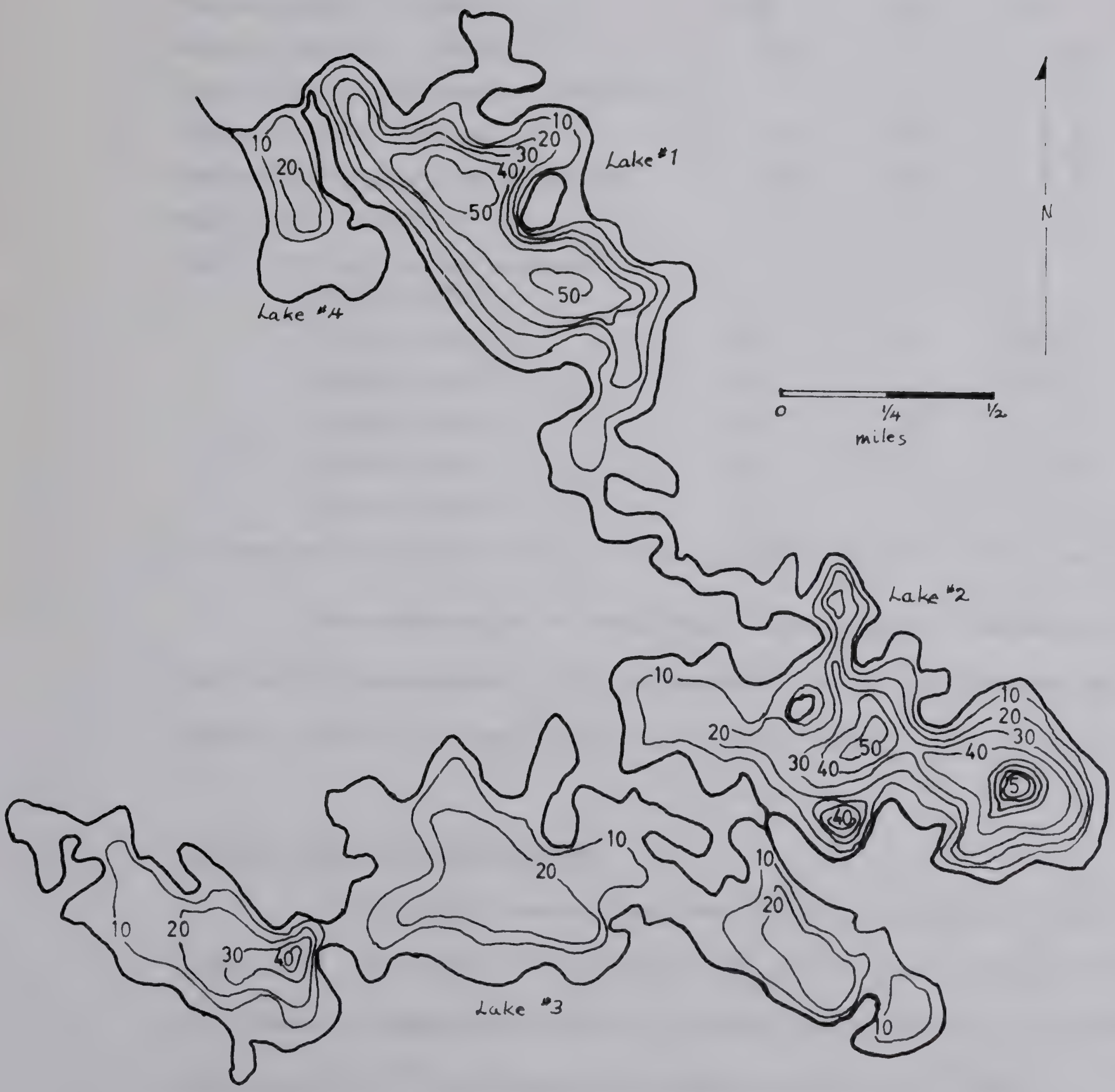


Table I. Morphometry of Unnamed Lakes on Crown Creek (107-3-W4th).

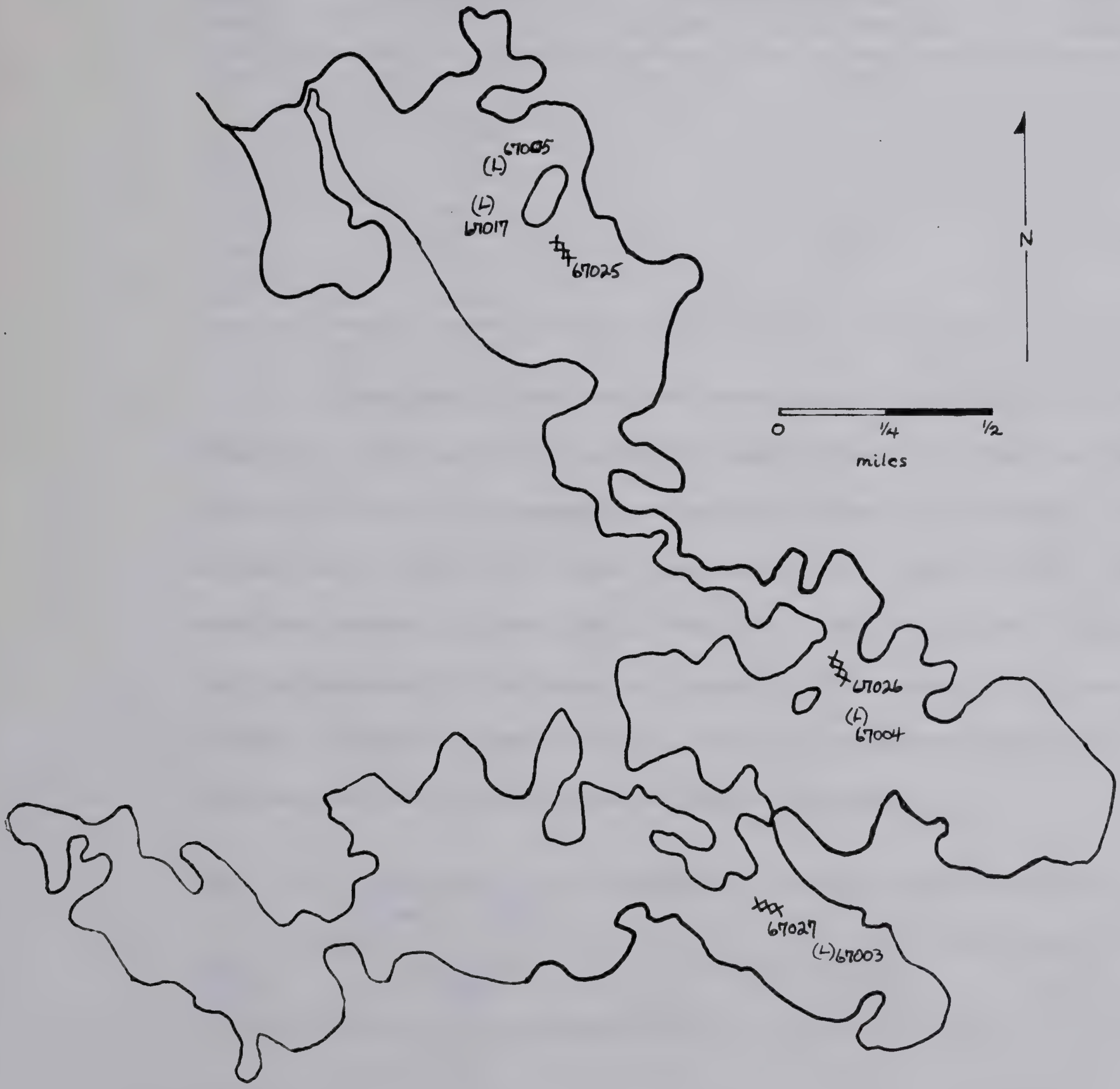
Lake Number	#1	#2	#3	#4
Area: (acres)	269	283	435	58
Shoreline: (miles)	5.1	4.8	8.1	1.3
Shoreline development factor:	2.2	2.0	2.8	1.2
Volume: (acre feet)	5300	5300	5100	450
Mean depth: (feet)	20	19	12	8
Maximum depth: (feet)	58	50	45	28
Maximum length: (miles)	1.3	1.2	2.2	0.5
Maximum effective length: (miles)	1.1	1.2	1.5	0.5
Maximum width: (miles)	0.5	0.6	0.6	0.3
Maximum effective width: (miles)	0.5	0.5	0.5	0.3
Mean width: (miles)	0.3	0.4	0.3	0.2
Depth distribution as percent surface area:				
10 feet plus:	60	64	49	33
20 feet plus:	40	43	22	5
30 feet plus:	29	25	1.5	-
40 feet plus:	19	11	0.5	-
50 feet plus:	5	2	-	-

The morphometry of these four lakes generally indicates that they could be eutrophic. This is generally due to the low mean depths and the relatively large shoal areas in each lake.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made on Lake #3 on June 23, 1967 (Figure 2). The depth at the station was 23 feet, and there was little difference in temperature from the surface to the bottom, the surface waters being 13.7°C and the bottom waters being 10.5°C. The concentration of dissolved oxygen was good, being about 85% saturation

Figure 2. Net sets (xxx) and limnology stations (L) on Unnamed Lakes on Crown Creek.



(Table II). The transparency of the water, as measured with a secchi disc was 18 feet. The pH (as measured with a Hellige color comparator) was alkaline, ranging from 7.4 at the surface to 7.6 at the bottom.

Table II. Observations at Limnological Station 67003 on Lake #3, June 23, 1967 at 3:30 p.m.

Depth (feet)	Temperature (°C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)
0	13.7	9	85	7.4
5	13.6			
10	13.2			
15	12.9			
20	12.7	9	85	7.6
23	10.5			

Limnological observations were made on Lake #2 on June 24, 1967 (Figure 2). The depth at the station was 21 feet, and there was very little difference in temperature from the surface to the bottom, the surface waters being 15.5°C and the bottom waters being 12.5°C. The dissolved oxygen was good, being from 90 to 100% saturation (Table III). The transparency of the water, as measured with a secchi disc, was 17 feet. The pH (as measured with a Hellige color comparator) was alkaline, being 7.6 at both the surface and bottom.

Table III. Observations at Limnological Station 67004 on Lake #2, June 24, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)
0	15.5	10	100	7.6
5	15			
10	14			
15	13			
20	13	9	90	7.6
21	12.5			

Limnological observations were made on Lake #1 on June 24, 1967 (Figure 2). The depth at the station was 53 feet, and a thermocline was evident from 30 to 33 feet. The dissolved oxygen was high in the epilimnion, being 100% saturation at the surface, but there was some oxygen depletion in the hypolimnion, the dissolved oxygen being 55% saturation at 50 feet. The pH (as measured with a Hellige color comparator) was 7.6 at the surface but had decreased to 7.0 at 50 feet (Table IV). This indicates a good rate of decomposition occurring on the bottom. The transparency of the water, as measured with a secchi disc, was 24 feet.

Table IV. Observations at Limnological Station 67005 on Lake #1, June 24, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen p.p.m.	% saturation	pH (Hellige)
0	15	9	100	7.6
5	15			
10	14			
15	13			
20	13			
25	12.5			
30	12			
33	7.5			
35	6.5			
40	5.5			
45	5			
50	4.5	7	55	7.0
53	4			

A second series of observations was made on Lake #1 (station 67017) on August 19, 1967 at 3:00 p.m. (Figure 2). The depth at the station was 45 feet, and a thermocline was evident between 30 and 40 feet. The dissolved oxygen was high in the epilimnion, being 105% saturation at 30 feet and 100% saturation at the surface. In the hypolimnion, however, oxygen depletion was evident, the water having 40% saturation level at 45 feet. The pH was more alkaline at the surface and in the hypolimnion than it had been during June, as the pH at this time was greater than 7.6 in the epilimnion and 7.4 at 45 feet. The conductivity of the water was measured with a conductivity meter, and ranged from 116 to 143 mmhos/cm (standardized to 18°C). Transparency, as measured with a secchi disc, was 25 feet. The lake was evidently both thermally and chemically stratified at this time (Table V).

Table V. Observations made at Limnology Station 67017 on Lake #1, August 19, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)	Conductance (mmhos/cm @ 18°C)
0	21	9	100	7.6+	116
5	19.5				
10	19				
15	19				
20	18.5				
25	18.5				
30	18	10	105	7.6+	122
35	13.5				
40	9				
45	8	5	40	7.4	143

Water samples were taken at each limnology station and analyzed with a Hach kit. pH, however, was determined with a Hellige color comparator and specific conductance was measured with a Beckman conductivity meter, and the conductance values then standardized to 18°C.

Table VI. Water Chemistry, Unnamed Lakes on Crown Creek.

Sample Number	67001	67002	67004	67005	67006	67007	67066	67067	67068
Limnology station	67003	67003	67004	67004	67005	67005	67017	67017	67017
Depth (feet)	20	0	20	0	50	0	0	30	45
Temperature (°C)	12.7	13.7	13	15.5	4.5	15	21	18	8
Ph. alkalinity (p.p.m. $CaCO_3$)	0	0	0	0	0	0	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	80	70	80	65	70	70	80	75	75
Calcium hardness (p.p.m. $CaCO_3$)	35	25	35	30	35	35	45	30	45
Total hardness (p.p.m. $CaCO_3$)	60	60	75	70	75	70	60	70	75
Chlorides (p.p.m.)	7.5	10	5	15	7.5	7.5	7.5	5	5
pH (Hellige)	7.4	7.6	7.6	7.6	7.0	7.6	7.6+	7.6+	7.4
Conductance (mmhos/cm @ 18°C)	-	-	-	-	-	-	116	122	143

The specific conductance of the waters in Lake #1 is quite high and indicates a relatively large quantity of dissolved nutrients in the water. Since the other characteristics of the water measured are quite similar for all the lakes, it is reasonable to assume that the specific conductance, and hence the dissolved nutrients would be about the same for all four lakes.

The limnology and water chemistry on these lakes indicate that they are relatively eutrophic and thus fairly productive. Contrary to this, however, are the high transparency values observed at all the limnology stations.

PLANKTON

Plankton hauls were made at each limnology station with a Wisconsin type-plankton net (mouth diameter of 20 cm). These samples were preserved and analyzed later in the laboratory and the organisms classed according to their relative abundance (Table VII).

Table VII. Plankton from Unnamed Lakes on Crown Creek. The relative abundance of the organisms is indicated as follows: very abundant--va, abundanct--a, common--c, scarce--s, rare--r, or absent--x.

Limnology station	67003	67004	67005	67017
Diatoms				
Deborya	x	s	x	x
Asterionella	x	x	a	a
Frustulia	x	s	r	x
Tabellaria	c	x	c	a
Blue-green algae				
Gloeotrichia	x	x	x	c
Zygnema	r	x	x	x
Green algae				
Ulothrix	x	r	x	x
Dinoflagellates				
Ceratium	x	x	c	a
Rotifers	c	c	c	a
Crustaceans				
Copepods	c	s	s	c
Cladocera	r	s	r	r

The plankton was very sparse in these lakes, which was reflected in the high transparency values measured with the secchi disc. The plankton consisted of very few species, and generally was typical of lakes of low productivity, as few green algae were found in the samples, the type most common being the diatoms. The copepods were the most abundant zooplankters, few cladocera being found. In general the plankton samples indicate low productivity in these lakes.

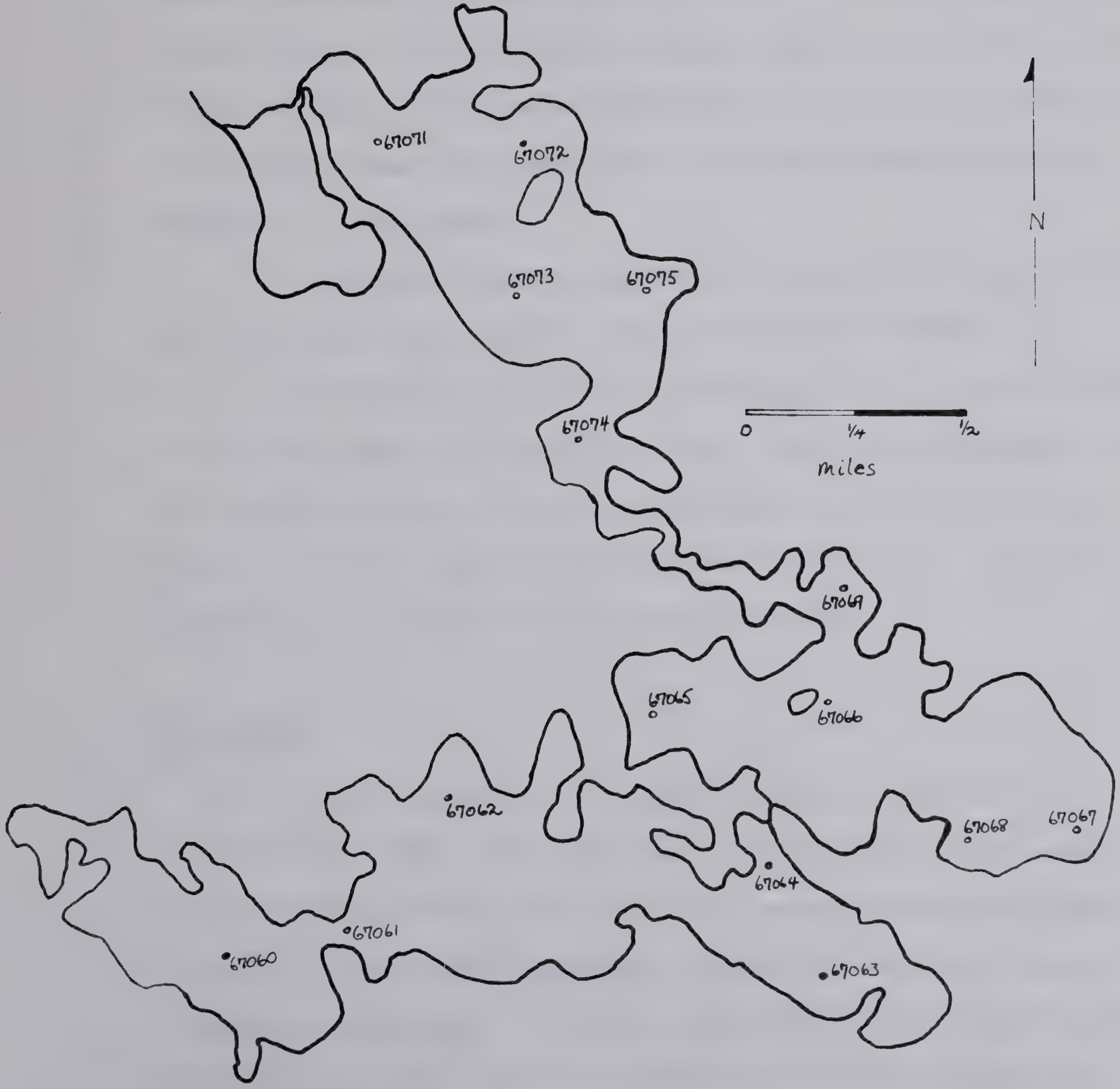
BOTTOM FAUNA

Fifteen bottom samples were taken from three Unnamed Lakes on Crown Creek from June 18 to 25, 1967 (Figure 3). Each sample consisted of four hauls with a six inch square Ekman dredge, which were washed through a screen-bottomed bucket (25 meshes per inch) and all living organisms preserved. These were classified according to major groups, counted, and their displaced volume determined (Table VIII).

Table VIII. Bottom Fauna from Three Unnamed Lakes on Crown Creek.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Amphipoda	Ephemeroptera	Chironomidae	Other Diptera	Gastropoda	Pelecypoda	Others	Total	Displaced Volume (cc)
67060	30	Sand, muck	-	5	-	5	-	-	2	-	12	0.10
67061	8	Sand	-	11	12	16	-	-	10	-	49	0.35
67062	16	Muck	-	-	-	1	1	-	-	1	3	0.05
67063	22	Sand, muck	-	5	-	6	4	-	10	-	25	0.20
67064	6	Muck	-	9	-	-	-	-	-	-	9	0.05
67065	6	Muck	-	-	-	-	-	-	-	-	0	0
67066	4	Sand	10	70	-	-	-	-	-	-	80	0.20
67067	40	Sand	25	65	-	9	-	-	3	-	102	0.35
67068	30	Sand, muck	2	42	-	8	-	-	-	-	52	0.20
67069	25	Sand, muck	-	10	-	40	4	-	3	-	57	0.15
67071	32	Muck	-	-	-	7	-	-	-	-	7	0.20
67072	48	Muck	-	-	-	6	-	-	-	-	6	0.15
67073	4	Sand	8	40	70	40	1	2	13	2	176	1.00
67074	20	Muck	-	4	-	1	-	4	1	-	10	0.05
67075	27	Muck	-	-	-	220	-	-	4	1	225	0.70
Average/square meter			32	187	59	258	7	4	33	2	583	2.69
Percent of total number			6	32	10	44	1	1	6	-		

Figure 3. Bottom sampling station on Unnamed Lakes on Crown Creek.



From the bottom samples (Table VIII) it can be seen that most of the lake bottom consists either sand or organic muck. In most cases the organic muck was well decomposed, although in Lake #2 it was rather flocculent. There was little evidence of rooted aquatic plants in the lakes, which would probably tend to lower their productivity.

An average of 583 organisms per square meter was found, having a displaced volume of 2.69 cc. This is very poor and indicates a poor source of food for bottom feeding fishes, such as lake whitefish. This, coupled with the sparse rooted aquatic vegetation, and hence a poor fauna in that area, may tend to limit the population of lake whitefish in these lakes.

The bottom fauna would tend to indicate that these lakes are not very productive, possibly due to some physical factors.

The dominant organisms in the samples were chironomids (44% of the total number) and amphipods (32%). Mayflies represented 10% of the bottom organisms while oligochaetes were only 6% of the total number of bottom organisms in the samples (Table VIII). All other organisms were insignificant in volume and number.

FISH FAUNA

Test nets were set in three locations (Figure 2) between June 19 and 24, 1967. Each mesh size was 50 yards in length, and 2½, 3½, 4½ and 5½ inch mesh nets were set. Fish caught included pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*) and white suckers (*Catostomus commersoni*). It may be noted that pike and lake whitefish dominated the catch in Lake #1, while white suckers dominated the catches in Lakes #2 and #3 (Table IX).

Table IX. Test Net Results, Unnamed Lakes on Crown Creek, June 19 to 24, 1967.

Net Set No.	Depth (feet)	Mesh Size (ins)	Northern Pike	Lake Whitefish	White Suckers	Total
67025	48	2½	29	1	2	32
67025	48	3½	10	3	1	14
67025	48	4½	-	20	-	20
67025	48	5½	-	13	-	13
67026	15	2½	6	-	2	8
67026	30	3½	3	2	9	14
67026	45	4½	-	9	14	23
67026	40	5½	1	10	1	12
67027	15	3½	2	-	8	10
67027	15	4½	-	-	15	15
67027	15	5½	-	-	1	1
	Totals		51	58	53	162

The pike were quite small, and were caught mostly in the 2½ inch mesh nets, although some were caught in the 3½ inch mesh nets. The lake whitefish were caught mostly in the 4½ and 5½ inch mesh nets, while the white suckers were caught largely in the 4½ inch mesh nets. No tullibee were caught in the nets, but they may be present, although too small to be caught in the 2½ inch mesh nets, which was the smallest mesh size set.

On June 23, 1967, the small connection between Lakes #2 and #3 was treated with rotenone. Fish collected included nine-spined sticklebacks (_Pungitius pungitius_), spottail shiners (_Notropis hudsonius_), pike (_Esox lucius_), burbot (_Lota lota_), perch (_Perca flavescens_) and white suckers (_Catostomus commersoni_).

Lake Whitefish

Fifty-eight lake whitefish were caught in gill nets between June 19 and 24, 1967. Fifty-two of these were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination (Table X).

Tabe X. Lake Whitefish from Unnamed Lakes on Crown Creek, June 18 to 24, 1967. Number in Sample: 52.

Age Class	n	♀♀	No. Mature	Fork Length (mm) $\bar{x}$	Sx	range	Weight (g) $\bar{x}$	Sx	range
V+	3	0	2	450		445-455	1330		1260-1370
VI+	17	7	16	462	±4.7	427-298	1408	± 39	1100-1660
VII+	21	13	21	470	±4.6	436-505	1455	± 48	1080-1915
VIII+	8	7	7	492	±9.5	448-525	1706	±105	1340-2190
IX+	2	2	2	508		479-536	1830		1480-2180
XI+	1	1	1	539			2530		

These fish ranged in age from five to eleven years, the most abundant age classes in the sample being age classes VI and VII. These fish must be relatively fast growing for the first years of their life as the three fish in age class V had a mean fork length of 450 mm and a mean weight of 1330 grams. The increase in size after age class VI is not very substantial (Table X).

The lake whitefish in these lakes appear to be maturing during their fifth year, and spawn in that year. The spawning habitat appears to be more than adequate for this species in these lakes.

The greatest limitation on this population is probably lack of food, which is probably quite severe, as the zooplankton did not appear to be very abundant in the plankton samples taken and the benthic fauna was definitely sparse. There was also very little rooted aquatic vegetation in the lake, which would decrease the amount of food organisms present.

Thirty lake whitefish were examined for plerocercoids of _Triaenophorus crassus_. Seventeen (57%) were found infected with a total of 57 cysts. The total weight of the thirty fish was 106 pounds, which gives a rate of infectation of 54 cysts per 100 pounds of fish. This is too high to be of value on the commercial market without first filleting them.

White Suckers

Fifty-three white suckers were caught in gill nets between June 19 and 24, 1967. Fifteen of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for age determination (Table XI).

Table XI. White Suckers from Unnamed Lakes on Crown Creek, June 19 to 24, 1967. Number in Sample: 15.

Age Class	n	♀♀	Fork Length (mm)			Weight (g)		
			$\bar{x}$	Sx	range	$\bar{x}$	Sx	range
IV+	2	0	455		450-460	1245		1240-1250
V+	13	6	469	±7.6	428-506	1450	±78	1130-1950

The white suckers in these lakes appear to be fairly abundant from the test netting results (Table XI). From the small sample examined, it seems they are early maturing, as all the fish were mature, even those in age class IV.

The fish examined were only of two age classes, IV and V.

They must be relatively fast growing, as those in age class V had a mean fork length of 469 mm and a mean weight of 1450 grams.

The habitat for this species would appear to be better in Lakes #2 and #3 rather than Lake #1, and this is born out by the greater number of suckers being caught in Lakes #2 and #3 than in Lake #1.

DISCUSSION AND CONCLUSION

The morphometry of these lakes suggests a fair level of productivity and there appears to be an adequate amount of dissolved nutrients in the water. However, all the biological sampling would tend to indicate the opposite, as the plankton was very sparse on two different occasions, and the bottom fauna also appears to be very poor. The poor productivity of these lakes may be due to the nature of the substrate, as the shores and all the shallow areas of the lakes are very sandy and support little rooted aquatic vegetation.

Using a morpho-edaphic index (Ryder, 1965), total annual production of about 5 pounds per acre for Lake #1 is indicated. This would probably be similar for Lake #2, but somewhat higher for Lake #3. However, only about half of this could be expected in the form of lake whitefish, which would be about 2.5 pounds per acre, or a total of 2500 pounds of lake whitefish per year from all four lakes.

Since the lake whitefish are infested with plerocercoids of *Triaenophorus crassus*, their value is greatly diminished and it probably would not be profitable to have a commercial fishery for this species on this lake until this area is easily accessible.

CROWN CREEK

Crown Creek was examined on June 24, 1967 about two miles downstream from the Unnamed Lakes on this stream which were being surveyed at this time. This creek drains directly into Lake Athabasca.

The mean width of the stream in this area was about 25 feet, with depths up to about three feet. The stream was very slow moving and no riffle areas were noticed. Beaver had dammed up the stream in various locations, creating small ponds.

The bottom consisted mostly of soft mud and sand. There were substantial amounts of aquatic vegetation in the stream and the immediate shore was muskeg or swampy. The surrounding country was gently rolling, with sandy ridges covered with small jack pine interspersed with areas of muskeg.

Roteneone was used to collect specimens of fish from the stream. Those collected included nine-spined sticklebacks (Pungitius pungitius), spottail shiners (Notropis hudsonius), northern pike (Esox lucius), burbot (Lota lota), perch (Perca flavescens) and white suckers (Catostomus commersoni).

In summary this stream did not appear to have much potential for a fishery.

BRANDER LAKE (109-1-W4th)

INTRODUCTION

Brander Lake was surveyed in the period June 25 to 29, 1967. This lake is about 150 miles northeast of Fort McMurray, Alberta and is inaccessible during the summer except by float plane. It is located in Township 109, Range 1, West of the Fourth Meridian, very close to the Saskatchewan border. There is no stream entering the lake and none draining it. As the drainage basin appears very small, the lake level must be maintained by ground water intrusion.

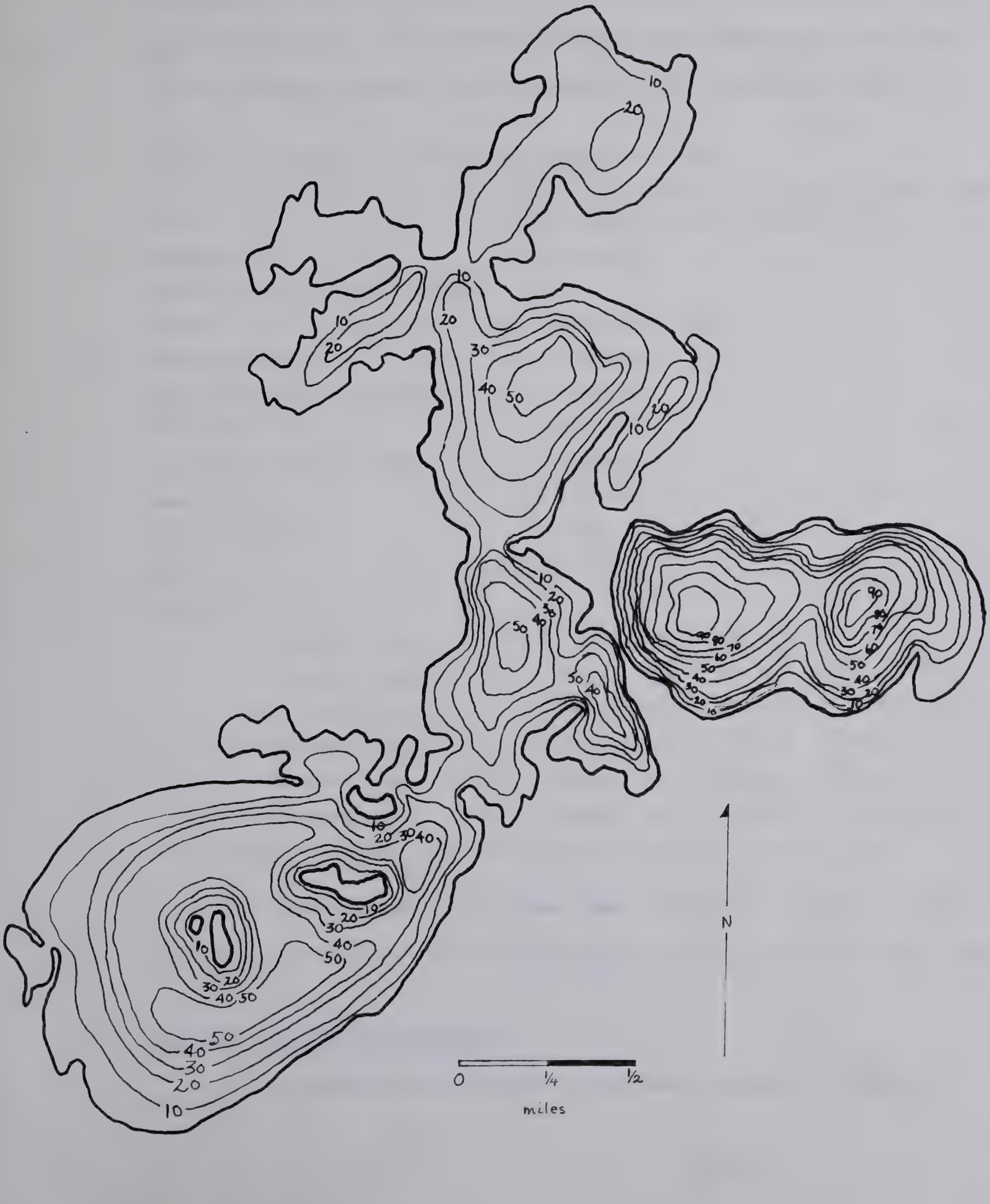
The surrounding country consisted of sand ridges and muskeg, with very small jack pine growing on the sand ridges and black spruce growing in much of the muskeg.

MORPHOMETRY

Depths were determined using an echo sounder and a contour map was constructed from the data collected (Figure 1). The lake volume and depth distribution were determined from this map, while other morphometric data were obtained from planimetric maps at a scale of one inch to one mile.

Brander Lake is quite small, with a total surface area of 2.17 square miles (1389 acres). The length of the shoreline (including the shoreline of four islands) is 16.0 miles, giving a shoreline development factor of 3.0, which means that this lake has an irregular shoreline. The maximum length of Brander Lake is 3.5 miles, while the maximum effective length is only 1.3 miles and the maximum width is 1.3 miles. The maximum effective width is 1.0 mile and the mean

Figure 1. Contour map of Brander Lake and Unnamed Lake (109-1-W. 4th M.)



width is 0.6 miles. The volume is estimated to be in the order of 28,000 acre feet, giving a mean depth of 20 feet. The maximum depth found was 56 feet. As can be seen from the depth distribution, a large part of the lake is very shallow, and only small portions of the lake are deep enough to permit stratification during the summer (Table I).

Table I. Morphometry of Brander Lake (109-1-W4th)

Area:	2.17 square miles (1389 acres)	
Shoreline:	16.0 miles	
Shoreline development factor:	3.0	
Volume:	28,000 acre feet	
Maximum length:	3.5 miles	
Maximum effective length:	1.3 miles	
Maximum width:	1.3 miles	
Maximum effective width:	1.0 miles	
Mean width:	0.6 miles	
Maximum depth:	56 feet	
Mean depth:	20 feet	
Depth distribution:		
surface area:	2.17 sq. mi. (1389 a.)	
10 feet plus:	1.44 sq. mi. (921 a.)	66% surface area
20 feet plus:	0.90 sq. mi. (576 a.)	42% surface area
30 feet plus:	0.58 sq. mi. (371 a.)	27% surface area
40 feet plus:	0.36 sq. mi. (230 a.)	16% surface area
50 feet plus:	0.10 sq. mi. (64 a.)	4% surface area

The morphometry of Brander Lake indicates it could be quite eutrophic, particularly the low mean depth and the very large shoal area.

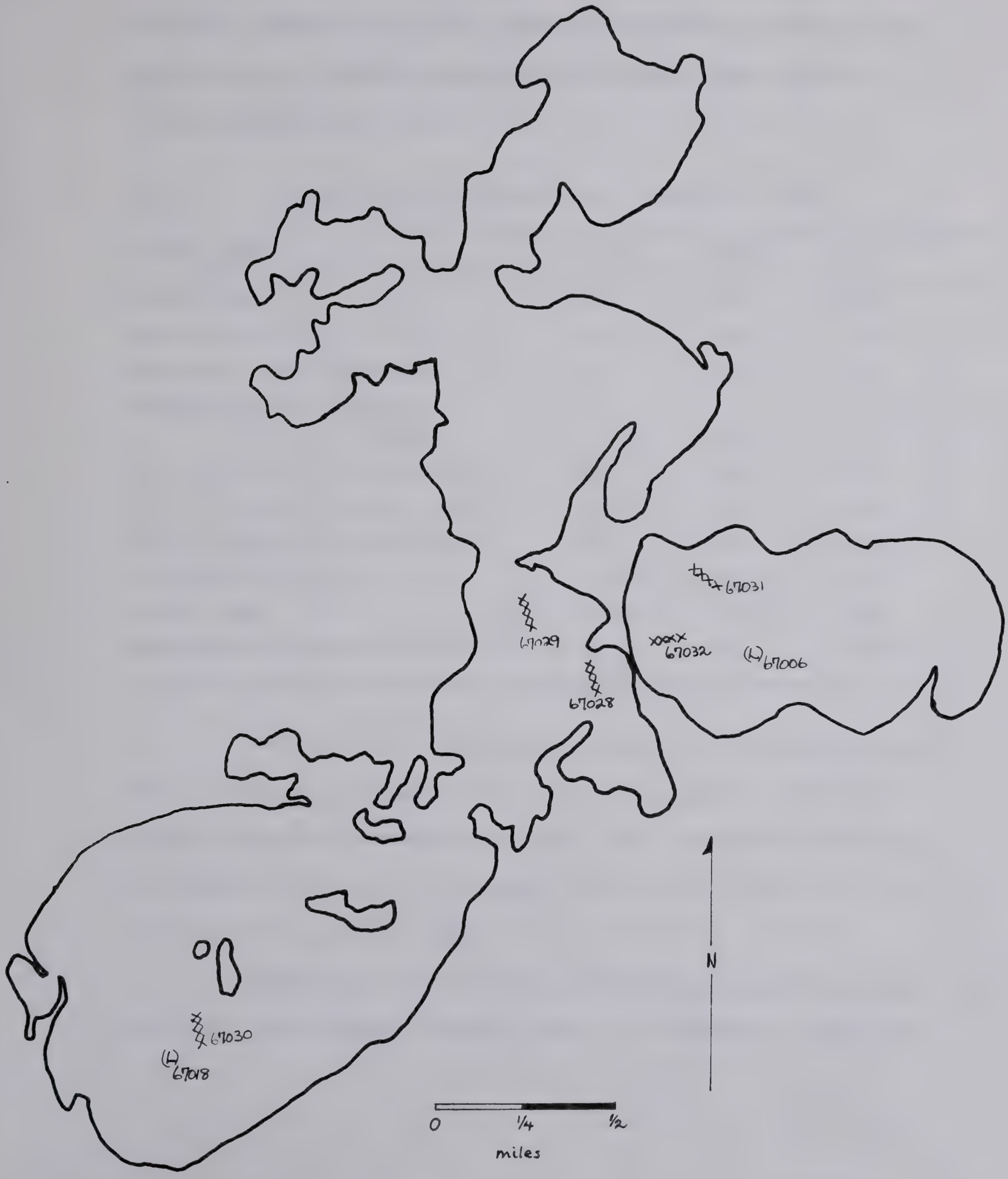
PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made on August 19, 1967 at station #67018 (Figure 2). At this time the lake was thermally and chemically stratified, the thermocline lying between 30 and 40 feet. Above the thermocline, the dissolved oxygen concentrations were high, ranging from 85% saturation at the surface to 130% saturation at 30 feet. The high concentration at 30 feet may be due to the activity of the phytoplankton, which was quite abundant in the lake at this time. The pH was alkaline in the epilimnion, being greater than 7.6 at the surface and 7.4 at 30 feet. Below the thermocline, the pH was slightly acidic, being 6.6 at 45 feet, and this, coupled with the complete absence of dissolved oxygen at 45 feet, indicates a high rate of decomposition occurring on the bottom. At this time the transparency of the water, measured with a secchi disc, was 14 feet (Table II).

Table II. Observations taken at Limnology Station #67018 on Brander Lake, August 19, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen		pH (Hellige)	Conductance (mmhos/cm)
		p.p.m.	% saturation		
0	19.5	8	85	7.6+	52
5	19				
10	19				
15	18.5				
20	18				
25	18				
30	16.5	13	130	7.4	55
35	12				
40	9.5				
45	8	0	0	6.6	62

Figure 2. Net sets (xxx) and limnology stations (L) on Brander Lake and Unnamed Lake (109-1-W. 4th M.)



Three water samples were taken at the limnology station on Brander Lake, August 19, 1967. The samples were analyzed with a Hach kit, except for pH, which was determined with a Hellige color comparator, and specific conductance, which was measured with a Beckman conductivity meter.

Table III. Water Chemistry, Brander Lake, August 19, 1967.

Sample Number	67069	67070	67071
Depth (feet)	0	30	45
Temperature (°C)	19.5	16.5	8
Dissolved oxygen (p.p.m.)	8	13	0
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	35	30	40
Calcium hardness (p.p.m. $CaCO_3$)	15	15	30
Total hardness (p.p.m. $CaCO_3$)	35	25	30
Chlorides (p.p.m.)	2.5	2.5	5
pH (Hellige)	7.6+	7.4	6.6
Conductance (mmhos/cm @ 18°C)	52	55	62

The water has relatively low alkalinity and hardness levels and a relatively low conductivity value, the specific conductance ranging from 52 to 62 mmhos/cm at 18°C. This indicates a low amount of dissolved nutrients in the water, which may be a limiting factor in the productivity of this lake.

Even though this lake has a relatively low amount of dissolved nutrients, other factors indicate that it is relatively productive.

PLANKTON

A plankton sample was taken at the limnology station on August 19, 1967 with a Wisconsin-type plankton net (mouth diameter of 20 cm). This was preserved and analyzed later in the laboratory, the organisms present being identified and their relative abundance determined (Table IV).

Table IV. Plankton from Brander Lake. A thirty-foot vertical haul was taken at the limnology station on August 19, 1967.

Organism	Relative abundance
Diatoms	
Asterionella	abundant
Tabellaria	abundant
Blue-green algae	
Anabaena	common
Coelosphaerium	rare
Gloeotrichia	rare
Dinoflagellates	
Ceratium	abundant
Rotifers	abundant
Crustaceans	
Copepods	common
Cladocerans	common

Plankton was quite abundant at the time the samples were taken, and was dominated by diatoms, while blue-green algae were also quite numerous. No green algae were found in the sample. The zooplankton consisted of copepods and cladocerans in about equal abundance. The plankton indicates a moderate level of productivity in Brander Lake.

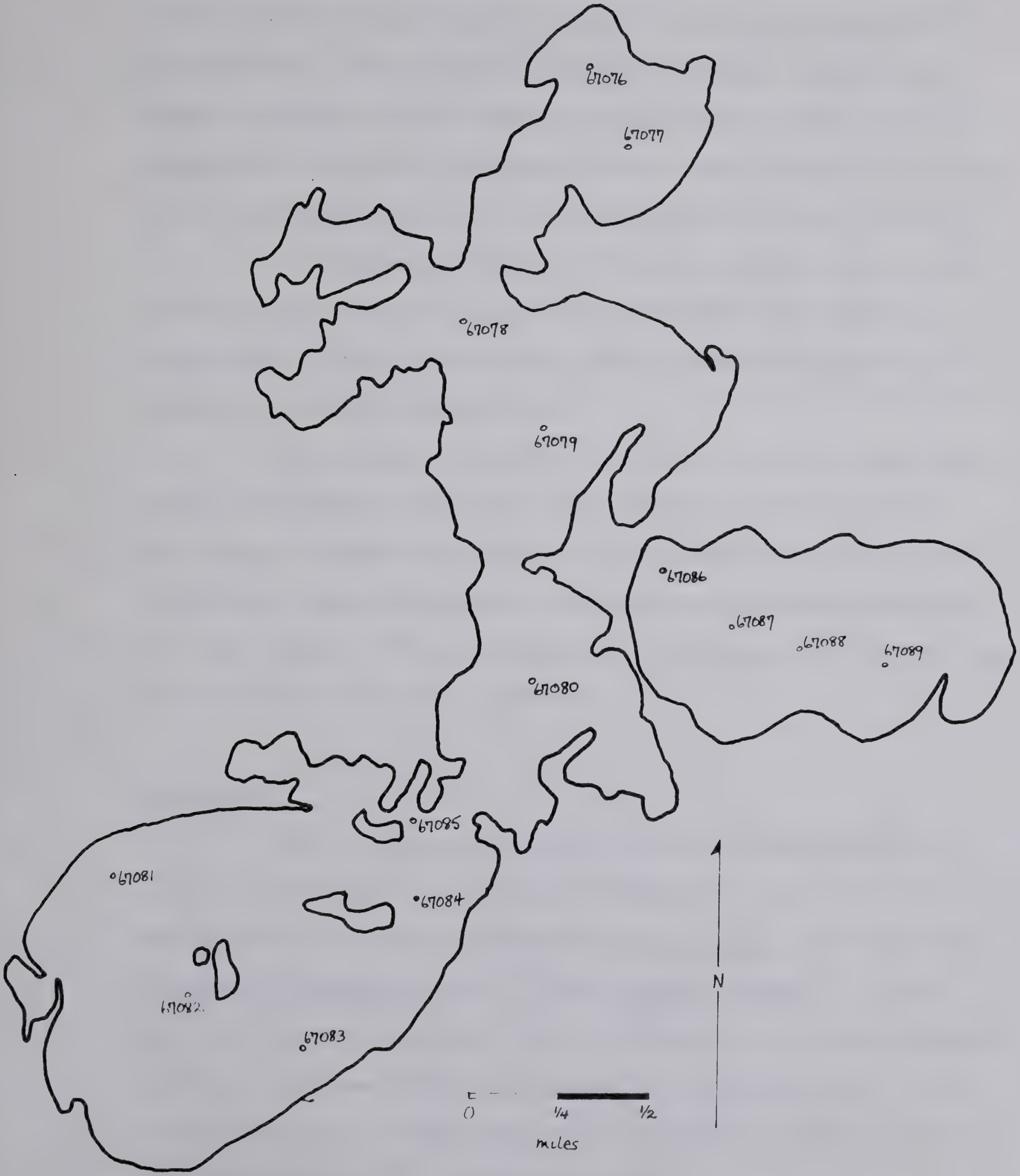
BOTTOM FAUNA

Ten bottom samples were taken on Brander Lake between June 25 and June 29, 1967 (Figure 3). Each sample consisted of four hauls with a six inch square Ekman dredge, which were washed through a screen bottomed bucket (25 meshes per inch) and all living organisms preserved. They were classified, counted, and their displaced volumes measured later in the laboratory (Table V).

Table V. Bottom Fauna from Brander Lake, June 25 to 29, 1967.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Hirudinea	Amphipoda	Ephemeroptera	Trichoptera	Chironomidae	Other Diptera	Others	Total	Displaced Volume (cc)
67076	16	Sand, muck	-	-	-	-	-	8	-	-	8	0.05
67077	22	Sand, muck	-	-	-	-	-	-	1	-	1	0
67078	8	Sand	20	4	5	-	3	51	-	-	83	0.40
67079	55	Muck	-	-	-	-	-	5	-	-	5	0.05
67080	43	Sand	3	-	-	-	-	39	-	2	44	0.30
67081	8	Sand	8	-	15	3	-	10	-	5	41	0.15
67082	29	Sand	2	-	-	-	-	60	-	-	62	0.20
67083	56	Muck	2	-	-	-	-	11	-	-	13	0.10
67084	49	Muck	-	-	-	-	-	4	2	-	6	0.05
67085	22	Muck	-	-	-	-	-	2	-	-	2	0.05
Average/square meter			38	4	22	3	3	205	3	8	285	1.45
Percent of total number			13	2	8	1	1	72	1	3		

Figure 3. Bottom sampling stations on Brander Lake and Unnamed Lake (109-1-W. 4th M.)



From the bottom samples it can be seen that the bottom material consists of sand or organic muck. Generally the sand predominates at the shallower depths, although it was found as deep as 43 feet (Table V). The shoreline is almost wholly sandy, but it would appear as though large portions of the lake support rooted aquatic vegetation, particularly the areas shallower than ten feet. This would tend to increase the number of fish food organisms present in the lake.

The average standing crop of bottom organisms was found to be 285 per square meter, with a volume displacement of 1.45 cc per square meter. This is very sparse, and may place limitations on a population of bottom feeding fishes.

The chironomids appeared to dominate the bottom fauna at all depths, and represent 72% of the total number of organisms in the ten samples. Oligochaetes were the next most abundant, comprising 13% of the total number of organisms, while the amphipods comprised 8% of the total number. All other organisms in the samples were insignificant in both numbers and volume (Table V).

FISH FAUNA

Test nets were set in three locations between June 25 and June 27, 1967 (Figure 2). Nets set included mesh sizes of 2½, 3½, 4½ and 5½ inch. Fish caught included pike (Esox lucius), lake whitefish (Coregonus clupeaformis) and tullibee (Coregonus artedi). From the test results, it would appear that lake whitefish are the most numerous species in the lake (Table VI), although pike were also taken in good numbers. Very few tullibee were taken, which may indicate a relatively small population of this species in the lake.

Table VI. Test Net Results, Brander Lake, June 25 to 27, 1967.

Net Set No.	Depth (feet)	Mesh Size (ins)	Pike	Lake Whitefish	Tullibee	Total
67028	6-45	2½	24	11	2	37
67029	25	3½	13	12	2	27
67029	35	4½	2	31	2	35
67029	40	5½	-	9	-	9
67030	45	3½	2	4	2	8
67030	50	4½	2	28	4	34
67030	55	5½	-	2	-	2
	Totals		43	87	12	152

Pike

Forty-three pike were taken. Thirty-one of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VII).

Table VII. Pike from Brander Lake.
Number in Sample: 31

Age Class	n	♀♀	Fork Length (mm)			Weight (g)		
			$\bar{x}$	Sx	range	$\bar{x}$	Sx	range
III+	6	3	428	±10.7	386-462	595	±35	460- 690
IV+	13	7	531	±17.1	452-626	1106	±89	700-1600
V+	8	6	597	±15.0	536-650	1382	±85	1120-1760
VI+	2	2	751		728-775	3145		2090-4200
VII+	2	2	839		811-867	3160		3520-3800

The fish in the sample ranged in age from three to seven years, and all the fish were mature, even those in age class III, indicating that these fish mature very early. The pike from Brander Lake appear to have a very good growth rate, as can be seen from Table VII. Fish in age class V have an average fork length of 597 mm and an average weight of 1382 grams. However, they appeared to be somewhat thin, and have relatively low weights for their lengths. This may be caused by a limited food supply.

The pike in the lake do have some potential as a sport fishery, but until the lake becomes readily accessible this potential will not be realized.

Lake Whitefish

Eighty-seven lake whitefish were taken (Table VI). Forty-nine of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VIII).

Table VIII. Lake Whitefish from Brander Lake.
Number in Sample: 49

Age Class	n	♀♀	Fork Length (mm) $\bar{x}$	Sx	range	Weight (g) $\bar{x}$	Sx	range
IV+	1	1	337			440		
V+	10	6	371	±10.6	309-415	751	±73	410-1100
VI+	8	3	400	± 9.0	351-428	886	±60	560-1100
VII+	12	4	413	± 6.8	389-460	1018	±64	760-1460
VIII+	8	3	433	± 8.4	400-468	1072	±49	900-1280
IX+	7	4	459	± 4.6	446-481	1294	±95	1000-1560
X+	4	2	462	± 4.2	452-472	1212	±77	1030-1400

The fish in the sample ranged from four to ten years of age and all the fish were mature (Table VIII). Lake whitefish in Brander Lake have a good growth rate, as can be seen from Table VIII. Fish in age class V have an average fork length of 371 mm and an average weight of 751 grams, which is quite good for lakes in northern Alberta. It may be noted here that there was great variability in the sizes of the fish in each age class, and that the growth rate appeared to slow down after age class VII.

The spawning habitat for lake whitefish in this lake is more than adequate, but the bottom fauna is poor and may severely limit the size of the population of this species.

Thirty whitefish were examined for plerocercoids of Triaenophorus crassus. Twenty-four (80%) were found infested with a total of 143 cysts. The total weight of the thirty fish was 64 pounds, giving an infestation rate of 224 cysts per 100 pounds of fish. This is far too high for these fish to be used as human food on the commercial market, and their only use would be as animal food.

Tullibee

Twelve tullibee were caught in gill nets from June 25 to June 27, 1967. Eleven of these fish were examined, and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination.

The fish in the sample ranged in age from five to seven years, and all the tullibee examined were mature. These tullibee must have a relatively good growth rate, as at age class VI these fish had an average fork length of 371 mm and an average weight of 753 grams.

This is quite large for tullibee in northern Alberta lakes.

Table IX. Tullibee from Brander Lake.
Number in Sample: 11

Age Class	n	♀♀	Fork Length (mm) $\bar{x}$	Sx	range	Weight (g) $\bar{x}$	Sx	range
V+	3	1	350		338-365	640		590- 730
VI+	6	4	371	±7.8	339-393	753	±49	540- 900
VII+	2	2	400		379-420	980		860-1100

It is surprising that no younger tullibee were caught in the nets, as they should have been taken in the 2½ inch mesh nets. It may indicate that there are very few tullibee in Brander Lake.

DISCUSSION AND CONCLUSIONS

The morphometry of Brander Lake is favorable for a high level of productivity, but the amount of dissolved nutrients in the water is quite low and probably reduces the productivity of the lake.

Using a morpho-edaphic index (Ryder, 1965) a total annual production of about 3 pounds per acre is postulated. For Brander Lake this would mean a harvest of about 4000 pounds of fish per year. However, the lake whitefish are heavily infested with plerocercoids of *Triaenophorus crassus*, making them quite unsuitable for human consumption under the present system. The pike do offer some potential for a sport fishery, but this will not be realized until the area becomes readily accessible.

UNNAMED LAKE (109-1-W4th)

INTRODUCTION

This small unnamed lake was surveyed between June 25 and June 29, 1967. It is located about 150 miles northeast of Fort McMurray, Alberta and is inaccessible during the summer except by float plane. It lies just a few yards east of Brander Lake in Township 109, Range 1, West of the Fourth Meridian and the east end of this lake lies in the province of Saskatchewan. There are no streams entering or draining this lake, and the water level is presumably maintained by ground water intrusion.

The surrounding country consists of sandy ridges and muskeg, with small jack pine growing on the ridges and black spruce growing in much of the muskeg.

MORPHOMETRY

Depths were determined using an echo sounder and a contour map was constructed from the data collected (Figure 1, Brander Lake). The volume and depth distribution were determined from this map, while other morphometric data were obtained from planimetric maps at a scale of one inch to one mile.

This small, unnamed lake has a surface area of 0.50 square miles (320 acres). The length of the shoreline is 3.1 miles, giving a shoreline development factor of 1.2, which means that the shoreline is very regular and the lake approaches a circle in shape. The maximum length of the lake is 1.1 miles, as is the maximum effective length, while the maximum effective width and maximum width are 0.6 miles.

The mean width is 0.4 miles.

The volume is estimated to be in the order of 13,700 acre feet, giving a mean depth of 43 feet. The maximum depth found was 95 feet. As can be seen from the depth distribution (Table I), only a small portion of the lake is shallow and it drops off to a good depth rather abruptly. Most of this lake is deep enough to permit thermal stratification during the summer.

Table I. Morphometry of Unnamed Lake (109-1-W4th)

Area:	0.50 square miles (320 acres)	
Shoreline:	3.1 miles	
Shoreline development factor:	1.2	
Volume:	13,700 acre feet	
Maximum length:	1.1 miles	
Maximum effective length:	1.1 miles	
Maximum width:	0.6 miles	
Maximum effective width:	0.6 miles	
Mean width:	0.4 miles	
Maximum depth:	95 feet	
Mean depth:	43 feet	
Depth distribution:		
Surface area:	0.50 sq. mi. (320 a.)	
10 feet plus:	0.43 sq. mi. (275 a.)	86% surface area
20 feet plus:	0.37 sq. mi. (234 a.)	74% surface area
30 feet plus:	0.32 sq. mi. (203 a.)	64% surface area
40 feet plus:	0.26 sq. mi. (169 a.)	53% surface area
50 feet plus:	0.20 sq. mi. (131 a.)	41% surface area
60 feet plus:	0.16 sq. mi. (100 a.)	32% surface area
70 feet plus:	0.10 sq. mi. (67 a.)	21% surface area
80 feet plus:	0.05 sq. mi. (33 a.)	10% surface area
90 feet plus:	0.02 sq. mi. (15 a.)	5% surface area

The morphometry of this lake indicates that it could tend towards oligotrophy.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made on June 28, 1967 at 4:00 p.m. (#67006)(Figure 2, Brander Lake). At this time the lake was thermally and chemically stratified, the thermocline being between 25 and 35 feet (Table II).

Table II. Observations Made at Limnology Station #67006 on Unnamed Lake (109-1-W4)

Depth (feet)	Temperature (^{o}C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)
0	15.5	10	100	7.6+
5	14.5			
10	14			
15	14			
20	13			
25	12			
30	9.5	11	95	7.6
35	7.5			
40	6			
45	5	9	70	7.4
50	4.5			
60	4			
70	4	7	55	7.2
72	4			

In the epilimnion the dissolved oxygen concentrations were high, ranging from 95 to 100% saturation. In the hypolimnion, there was evidence of some oxygen depletion, as the concentration was only 55% saturation at 70 feet. This, coupled with the lower pH at 70 feet, indicates some decomposition occurring on the bottom, but not at a very substantial rate. At this time, the transparency of the water as measured with a secchi disc, was 26 feet, indicating a very small amount of plankton in the water.

Four water samples were taken at the limnology station on June 28, 1967. The samples were analyzed with a Hach kit, except for pH, which was determined with a Hellige color comparator (Table III).

Table III. Water Chemistry, Unnamed Lake (109-1-W4th)

Sample Number	67009	67010	67011	67012
Depth (feet)	0	30	45	70
Temperature (^{o}C)	15.5	9.5	5	4
Dissolved oxygen (p.p.m.)	10	11	9	7
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	95	100	100	100
Calcium hardness (p.p.m. $CaCO_3$)	50	45	50	45
Total hardness (p.p.m. $CaCO_3$)	85	90	100	95
Chlorides (p.p.m.)	7.5	5	7.5	7.5
pH (Hellige)	7.6+	7.6	7.4	7.2

The water has high alkalinity values and high hardness values for lakes in northern Alberta. This may indicate a relatively greater amount of dissolved nutrients in the lake, allowing the lake to be relatively productive for its morphometry.

The limnology and water chemistry on the small lake indicate that it is relatively oligotrophic, or perhaps mesotrophic.

PLANKTON

Plankton samples were taken at the limnology station on June 28, 1967 with a Wisconsin type plankton net (mouth diameter of 20 cm).

These were preserved and analyzed later in the laboratory, the organisms present being identified and their relative abundance recorded (Table IV).

Table IV. Plankton from Unnamed Lake (109-1-W4th)

Organism	Relative abundance
Diatoms	
Tabellaria	abundant
Dinoflagellates	
Ceratium	common
Rotifers	common
Crustaceans	
Copepods	abundant

The plankton was very sparse in this lake at the time of the survey, and there was little variety (Table IV). Only diatoms and dinoflagellates were present in the phytoplankton, while rotifers and copepods were the only representatives of the zooplankton. The composition and quantity of plankton is indicative of an oligotrophic condition.

BOTTOM FAUNA

Four bottom samples were taken on this lake on June 28, 1967 (Figure 3, Brander Lake). Each sample consisted of four hauls with a six inch square Ekman dredge, which were washed through a screen-bottomed bucket (25 meshes per inch) and all living organisms preserved. These were divided into groups, counted, and their displaced volumes measured later in the laboratory (Table V).

Table V. Bottom Fauna from Unnamed Lake (109-1-W4th)

Sample No.	Depth (feet)	Substrate								Total	Displaced Volume (cc)
67086	3	Sand	12	1	43	1	-	10	6	73	0.40
67087	75	Muck	-	-	-	-	60	-	-	60	0.50
67088	69	Muck	-	-	-	-	178	-	-	178	2.05
67089	69	Muck	-	-	-	-	10	-	-	10	0.10
Average/square meter			32	3	116	3	667	27	16	864	8.21
Percent of total number			4	-	13	-	77	3	2		

From the bottom samples it can be seen that the bottom material consists generally of sand or organic muck. The sand generally predominates in the shallower waters, while the organic muck, which appeared well decomposed in this lake, was found at greater depths. Most of the shoreline was sandy, and there was little evidence of rooted aquatic vegetation in this lake.

The average standing crop of bottom organisms was determined from the four samples to be 864 organisms per square meter, with a volume displacement of 8.21 cc (Table V). This is quite sparse, although the displaced volume is fair. The numbers of bottom organisms present may limit the size of a population of bottom feeding fish such as lake whitefish.

The chironomids dominated in the samples, and they were all that were found in the three deep samples, while none were found in the shallow sand sample. In this lake, they probably comprise the largest portion of the bottom fauna.

FISH FAUNA

Test nets were set in two locations on June 27, 1967 and lifted the following morning (Figure 2, Brander Lake). Nets set included mesh sizes of 2½, 3½, 4½ and 5½ inch. All nets were 50 yards in length except the 2½ inch mesh net which was 100 yards in length. Fish caught included pike (Esox lucius) and lake whitefish (Coregonus clupeaformis) (Table VI).

Table VI. Test Net Results, Unnamed Lake (109-1-W4th)

Net Set No.	Depth (feet)	Mesh Size (ins)	Pike	Lake Whitefish	Total
67031	60	3½	-	11	11
67031	60	4½	-	8	8
67031	60	5½	-	2	2
67032	4-55	2½	6	17	23

No tullibee were caught in the nets set in this lake, but they could be present, could be too small to be caught in the 2½ inch mesh nets, as that was the smallest size set. It would appear from the test netting that the lake whitefish are the most abundant species in the lake.

Pike

Only six pike were caught in the nets set in this lake, all being caught in the 2½ inch mesh net (Table VI). All were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VII).

Table VII. Pike from Unnamed Lake (109-1-W4th)
Number in Sample: 6

Age Class	n	♀♀	Fork Length (mm) $\bar{x}$	Fork Length (mm) range	Weight (g) $\bar{x}$	Weight (g) range
VIII+	1	0	558		1750	
IX+	2	0	604	599-610	1812	1800-1825
X+	2	1	694	663-724	2520	2340-2700
XI+	1	0	760		3560	

Even in a sample of such small size, these pike ranged in age from eight to eleven years. They appear to be relatively slow growing, the fish in age class X having an average fork length of 694 mm and an average weight of 2520 grams. They did not appear to be in good condition and were quite thin.

All the fish in the sample were mature, as could be expected, since the youngest fish was in age class VIII. The habitat for the species in this lake is probably not plentiful, as there is little shoal area in the lake and no evidence of rooted aquatic plants. The pike are probably not very numerous in this lake.

Lake Whitefish

Forty-four lake whitefish were taken (Table VI). Thirty-five of these fish were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VIII).

The fish in the sample ranged from four to eleven years of age, with age class VII and age class VIII being the most numerous. All the fish were mature, which means that they are maturing in their forth year or earlier. These fish do not appear to have a very good growth rate (Table VIII), fish in age class VIII having an average fork length of 381 mm and an average weight of 722 grams. It may be noted that these fish were very variable in length and weight within the age classes.

The spawning habitat for lake whitefish in this lake appears to be more than adequate, but the bottom fauna is quite sparse and this may limit the population. Their slow growth rate may reflect this condition.

Table VIII. Lake Whitefish from Unnamed Lake (109-1-W4th)
Number in Sample: 35

Age Class	n	♀♀	Fork Length (mm)			Weight (g)		
			$\bar{x}$	Sx	range	$\bar{x}$	Sx	range
IV+	2	1	328		312-343	425		330- 520
VI+	3	1	315		312-321	400		360- 440
VII+	14	8	338	±6.6	290-374	493	±35	300- 700
VIII+	13	7	381	±7.0	331-411	722	±43	450- 940
X+	2	2	405		371-439	860		660-1060
XI+	1	1	445			1240		

Thirty lake whitefish were examined for plerocercoids of Triaenophorus crassus. Seventeen (57%) were found infested with a total of 78 cysts. The total weight of the thirty fish was 41 pounds, which gives an infestation rate of 191 cysts per 100 pounds of fish. This is far too high for these fish to be used as human food, and their only use would be as animal food, so that their value in a commercial fishery is greatly diminished.

DISCUSSION AND CONCLUSIONS

This lake would appear to be somewhat oligotrophic, largely due to its morphometry. The bottom fauna and plankton were very sparse, indicating that the water is quite unproductive.

The two species of fish caught in the lake, the pike and the lake whitefish, had very poor growth rates, reflecting the unproductive nature of the lake.

Since the pike are so slow growing, and they are probably quite limited in number in this lake, they offer little potential for a sport fishery. The lake whitefish have a high rate of infestation with the pike-whitefish tapeworm, and have little value for a commercial fishery.

AGAR LAKE (106-1-W4th)

INTRODUCTION

Agar Lake is abour 140 miles northwest of Fort McMurray, Alberta and is inaccessible during the summer except by float plane. It is located in Township 106, Range 1, West of the Fourth Meridian. The lake has no inlet or outlet and the water level is presumably maintained by ground water. Agar Lake was surveyed between June 29 and July 4, 1967.

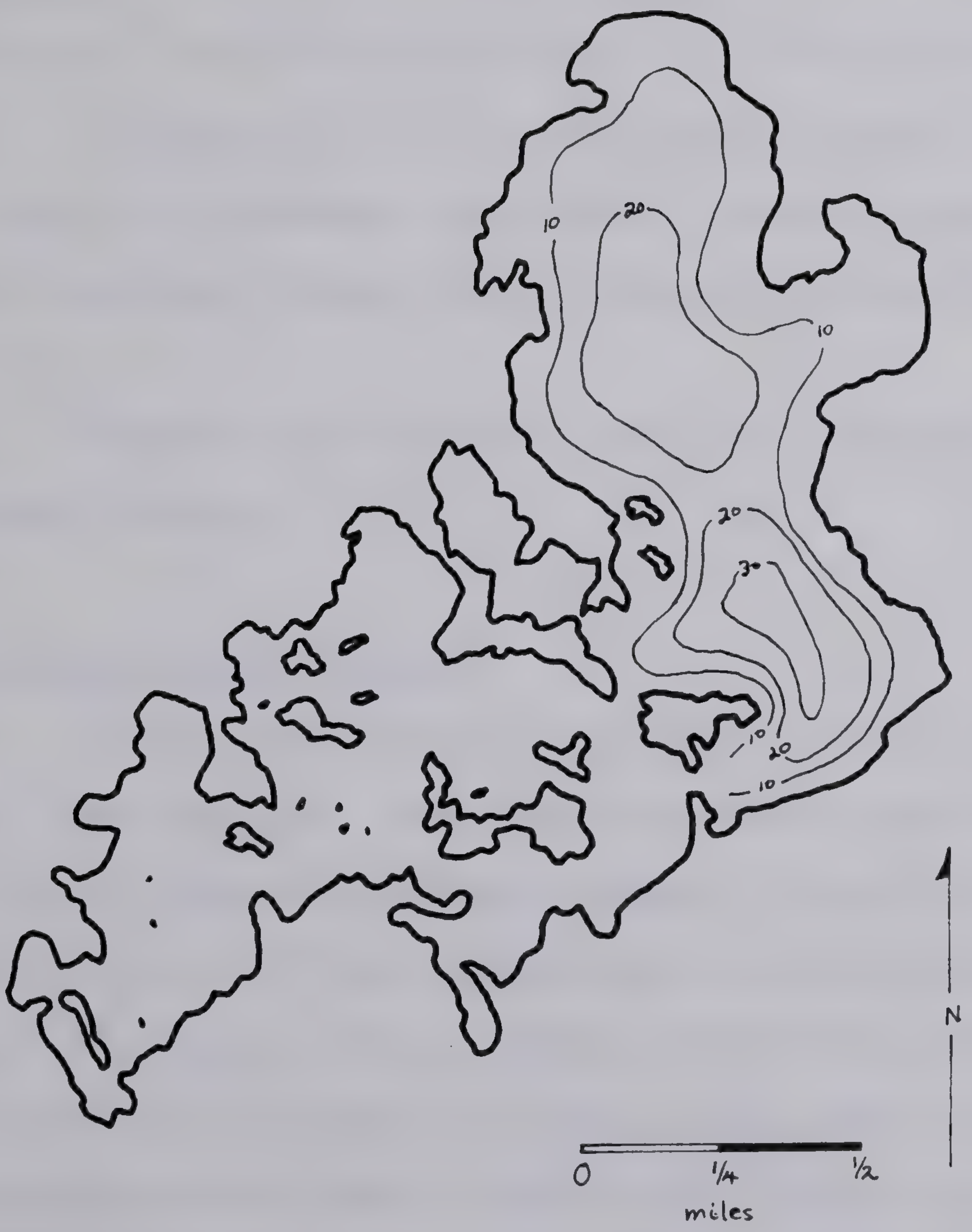
The surrounding country consists of sand ridges interspersed with muskeg. The sand ridges are covered with small jack pine, while the muskeg area has black spruce.

MORPHOMETRY

Morphometric data were obtained from planimetric maps at a scale of one inch to one mile. Depths were determined using an echo sounder and a sounding line, and a contour map was constructed from the data obtained (Figure 1). The map is incomplete as a result of lack of sounding data from that area of the lake containing a large number of islands, so that volume and depth distribution were not determined for this lake.

The surface area of the lake is 2.03 square miles (1299 acres). The shoreline of Agar Lake is 14.5 miles (including the shoreline of eleven islands) which gives a shoreline development factor of 2.9, meaning the shoreline is quite irregular and that a large portion of the lake is probably quite shallow. The maximum length of Agar Lake is 2.8 miles while the maximum effective length is 1.8 miles and the maximum width is 1.5 miles. The maximum effective width

Figure 1. Contour map of Agar Lake (incomplete).



is 1.2 miles while the mean width is 0.7 miles.

Table I. Morphometry of Agar Lake

Area:	2.03 square miles (1299 acres)
Shoreline:	14.5 miles
Shoreline development factor:	2.9
Maximum length:	2.8 miles
Maximum effective length:	1.8 miles
Maximum width:	1.5 miles
Maximum effecitve width:	1.2 miles
Mean width:	0.7 miles

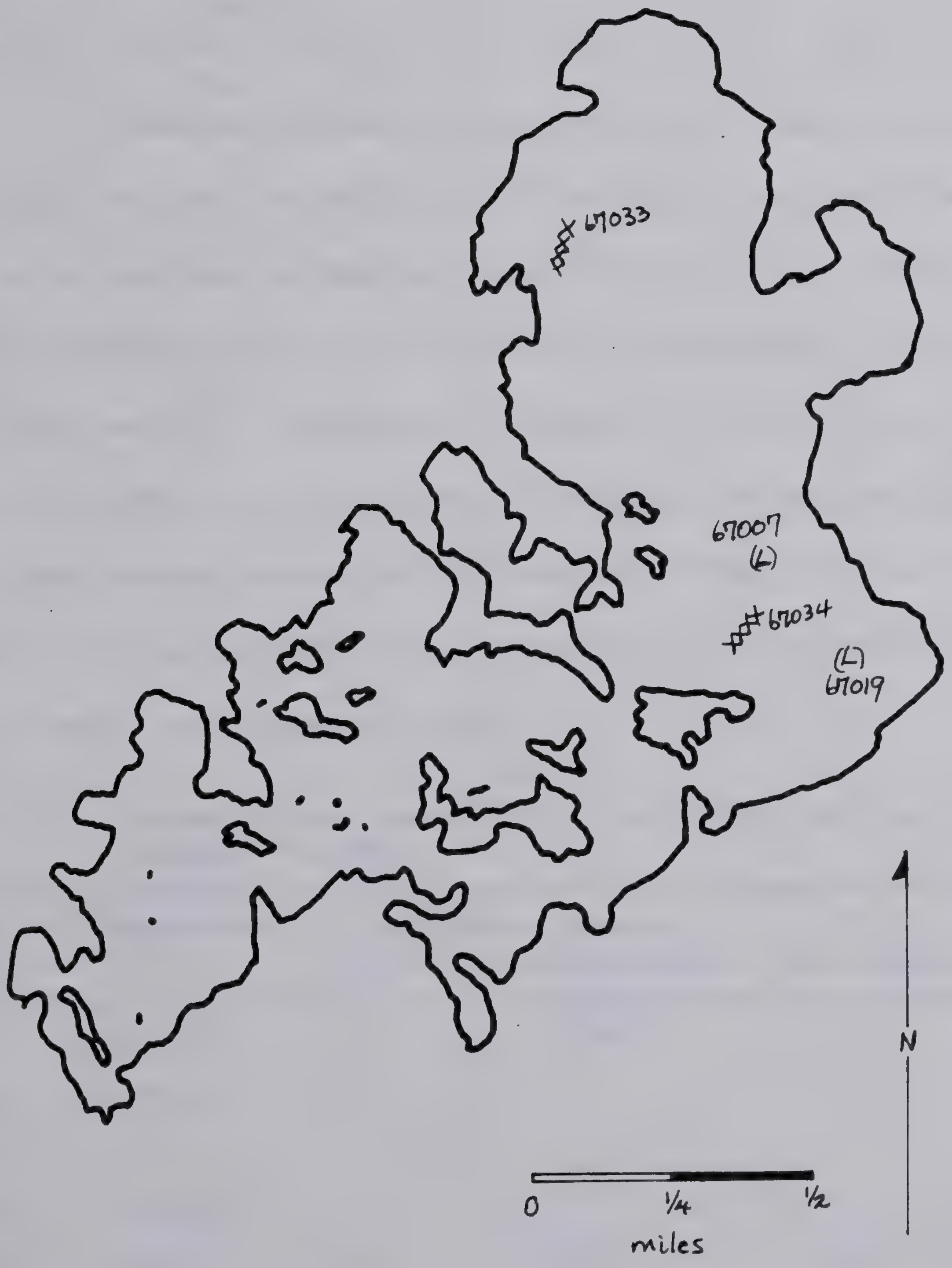
The portion of the lake with the large number of islands is probably not any deeper than 15 feet. The maximum depth found in the open water area was 35 feet. Undoubtedly the mean depth is quite low.

Generally the morphometry of Agar Lake indicates a eutrophic condition.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made at station #67007, July 4, 1967 (Figure 2). The depth at the station was 23 feet and there was no thermal stratification evident, as the surface water temperature was 15.5°C and the temperature at the bottom was 12.5°C. There did not appear to be any chemical stratification either, the pH being 7.2 at the surface, ten feet and twenty feet. The dissolved oxygen was quite high, being from 80 to 90% saturation from the bottom to the surface (Table II). The transparency of the water, as measured with a secchi disc, was 14 feet at this time, being reduced to an

Figure 2. Net sets (xxx) and limnology stations (L) on Agar Lake.



extent by the plankton in the lake.

Table II. Observations at Limnology Station #67007 on Agar Lake, July 4, 1967

Depth (feet)	Temperature (°C)	Dissolved oxygen		pH (Hellige)
		p.p.m.	% saturation	
0	15.5	9	90	7.2
5	16			
10	15	9	90	7.2
15	15			
20	14.5	8	80	7.2
23	12.5			

A second series of observations was made at station #67019 on August 19, 1967 at 4:30 p.m. (Figure 2). At this time the lake was quite warm and no thermal stratification was evident, as the surface temperature was 20.5°C and the temperature at the bottom (21 feet) was 17°C. There was no chemical stratification evident at this time either, the pH being 7.6 at the surface and 20 feet. The dissolved oxygen concentrations were still high, being from 85 to 90% saturation (Table III). The transparency of the water, as measured with a secchi disc, was 15 feet.

Table III. Observations made at Station #67019 on Agar Lake, August 19, 1967

Depth (feet)	Temperature (°C)	Dissolved oxygen		pH (Hellige)	Conductance (mmhos/cm)
		p.p.m.	% saturation		
0	20.5	8	90	7.6	86
5	19.5				
10	19				
15	18.5				
20	18	8	85	7.6	92
21	17				

Five water samples were taken on Agar Lake, three at station #67007 and two at station #67019. The water samples were analyzed with a Hach kit, except for pH, which was determined with a Hellige color comparator, and specific conductance, which was determined with a Beckman conductivity meter. The water was low in alkalinity and hardness and relatively high in chlorides (Table IV). The pH was 7.2 on July 4, 1967 but had increased to 7.6 by August 19, 1967. The specific conductance, taken only on August 19, 1967, ranged from 86 to 92 mmhos/cm (standardized to 18°C) which indicates only a moderate amount of dissolved nutrients in the water.

Table IV. Water Chemistry, Agar Lake. Samples 67013 to 67015 were taken at Limnology Station #67007 while the other two were taken at Limnology Station #67019

Sample Number	67013	67014	67015	67072	67073
Depth (feet)	20	10	0	0	20
Temperature (°C)	14.5	15	15.5	20.5	18
Dissolved oxygen (p.p.m.)	8	9	9	8	8
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	40	45	45	50	50
Calcium hardness (p.p.m. $CaCO_3$)	20	25	25	30	30
Total hardness (p.p.m. $CaCO_3$)	50	50	50	50	40
Chlorides (p.p.m.)	15	12.5	12.5	12.5	15
pH (Hellige)	7.2	7.2	7.2	7.6	7.6
Specific conductance (mmhos/cm @18°C)	-	-	-	86	92

The limnological observations indicate a eutrophic condition in this lake, but the productivity is probably limited by edaphic factors, particularly the relatively low level of dissolved nutrients in the water.

PLANKTON

Plankton samples were taken at each station, each sample being a total vertical haul with a Wisconsin type plankton net (mouth diameter of 20 cm). The samples were preserved and analyzed later in the laboratory, the organisms being identified and their relative abundance determined (Table V).

Table V. Plankton from Agar Lake. Sample #67007 was taken July 4, 1967 and Sample #67019 was taken on August 19, 1967.

Organism	Relative abundance	
	Sample #67007	Sample #67019
Diatoms		
Asterionella	abundant	abundant
Tabellaria	abundant	abundant
Fragilaria		rare
Blue-gree algae		
Anabaena	common	common
Microcystis		common
Gloeotrichia		rare
Dinoflagellates		
Ceratium	common	very abundant
Rotifers	abundant	common
Crustaceans		
Copepods	abundant	common
Cladocerans		common

The plankton taken on August 19, 1967 was more varied than the plankton taken on July 4, 1967. However, the same major groups of phytoplankton were represented in both samples. It may be noted that no green algae were taken in either sample. The plankton found is not typical of eutrophic lakes, which may be due to the latitude and the low dissolved nutrient level of the lake.

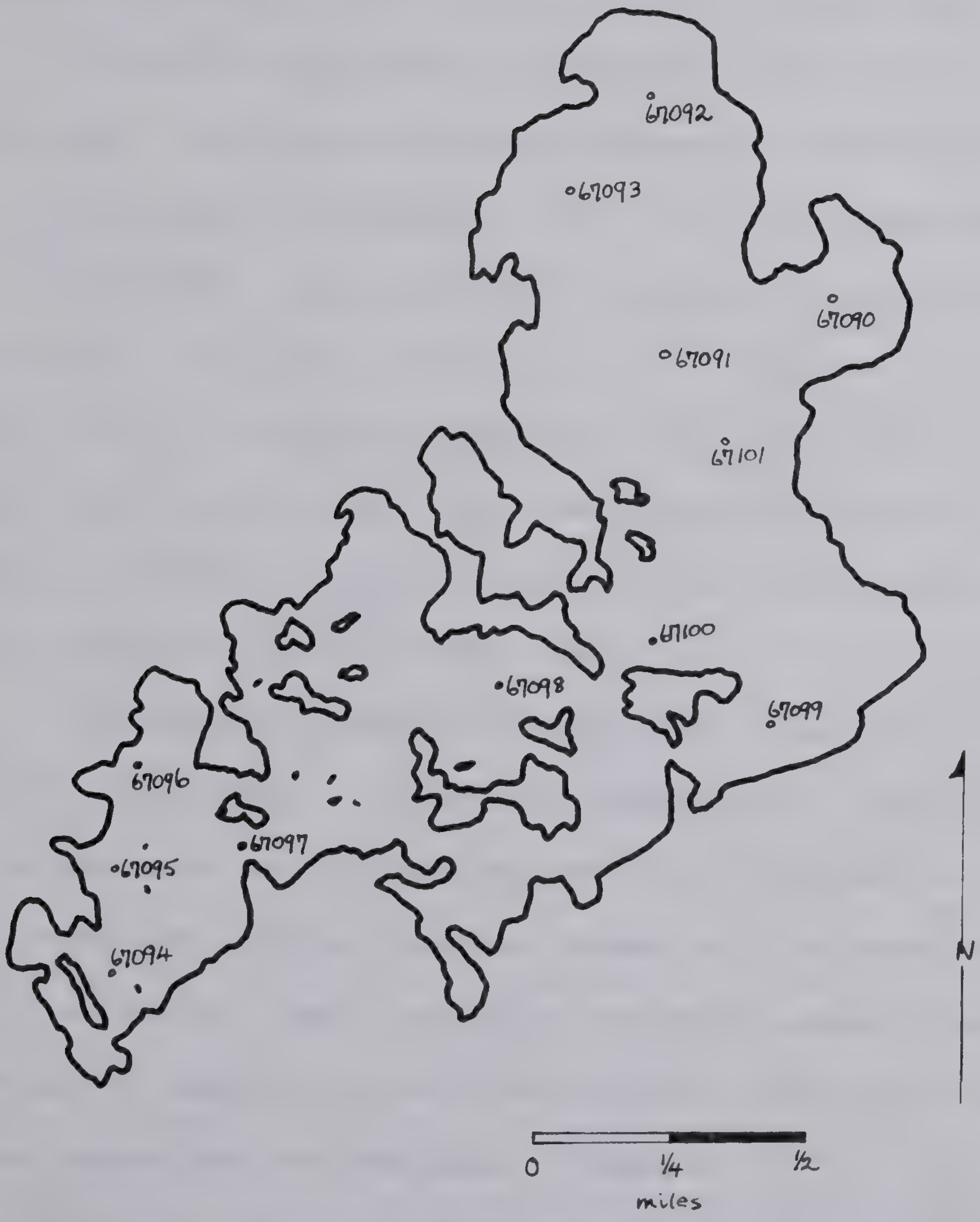
BOTTOM FAUNA

Twelve bottom samples were taken between June 29 and July 4, 1967, each consisting of four hauls with a six-inch square Ekman dredge (Figure 3). Each sample was washed through a screen-bottomed bucket (25 meshes per inch) and all living organisms preserved. These were classified and counted, and their displaced volumes measured (Table VI).

Table VI. Bottom Fauna from Agar Lake, June 29, to July 4, 1967.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Hirudinea	Amphipoda	Ephemeroptera	Trichoptera	Chlronomidae	Other Diptera	Pelecypoda	Others	Total	Volume (cc)
67090	11	Sand	10	1	90	3	6	25	-	2	4	141	0.45
67091	32	Muck	1	2	-	-	-	5	25	1	-	34	0.35
67092	7	Sand	2	-	25	1	1	49	-	4	-	82	0.15
67093	13	Sand, muck	-	-	115	18	-	30	3	10	1	177	0.35
67094	9	Muck	-	-	2	-	-	-	-	-	1	3	0.05
67095	10	Muck	-	-	3	-	-	10	1	-	-	14	0.05
67096	12	Muck	1	-	-	-	-	-	-	-	-	1	0
67097	9	Muck	1	1	4	-	-	5	-	-	-	11	0.05
67098	10	Sand, muck	-	-	9	-	-	3	1	-	-	13	0.05
67099	13	Muck	-	-	-	-	-	-	-	-	-	0	0
67100	20	Muck	-	-	4	-	-	2	-	-	-	6	0.05
67101	28	Muck	1	-	-	-	-	4	-	-	-	5	0.10
Average/square meter			14	4	226	20	6	119	27	15	5	437	1.48
Percent of total number			3	1	52	5	1	27	6	3	1		

Figure 3. Bottom sampling stations on Agar Lake



From the bottom samples it can be seen that most of the bottom material consists of sand or organic muck. The organic muck in the open water part of the lake appears to be well decomposed but in the area of the lake amongst the many islands the muck is quite flocculent and does not seem to be well decomposed. If the samples are closely examined and compared with respect to location, it seems that the bottom fauna is very sparse in the organic muck that is found in the island area of the lake. Most of the lake shoreline was sandy, although in some places it bordered on muskeg. Very few areas of gravel were found.

The bottom fauna seems quite sparse in this lake, the standing crop estimated from the twelve samples being 437 organisms per square meter with a volume displacement of only 1.48 cc per square meter. This is sufficiently low as to place limitations on a population of bottom feeding fish such as lake whitefish. It must be remembered, however, that the average was computed for all the samples, and six of these came from the area of the lake amongst the islands, which is probably too shallow to support much fish life. These samples contained very little bottom fauna (Table VI, Figure 3).

The dominant organisms in the samples were amphipods, comprising 52% of the total number. It must be remembered that these bottom organisms are quite small and do not contribute very much to the biomass, and this makes the average displaced volume low. Chironomids were second in abundance, comprising 27% of the total number of bottom organisms. Other organisms make up a significant portion of the bottom fauna, and these are broken down and tabulated in Table VI.

It does not appear as though the bottom fauna is very abundant in Agar Lake which may place limitations on a population of bottom feeding fish such as lake whitefish.

FISH FAUNA

Two net sets were made July 2, 1967 and lifted July 3, 1967 (Figure 2). Each set was 150 yards in length and consisted of 50 yards of each of 3½, 4½ and 5½ inch mesh nets. Fish caught included pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*) and white suckers (*Catostomus commersoni*)(Table VII).

Table VII. Test Net Results, Agar Lake, July 3, 1967.

Net Set No.	Depth (feet)	Mesh Size (ins)	Pike	Lake Whitefish	White Suckers	Total
67033	15	3½	4	9	-	13
67033	15	4½	1	15	1	17
67033	15	5½	-	2	-	2
67034	10	3½	3	27	-	30
67034	10	4½	-	42	-	42
67034	10	5½	-	18	-	18
	Totals		8	113	1	122

From the test net results, it would appear that the most abundant fish in the open water part of the lake are lake whitefish. No tullibee were caught in the nets but this does not mean they are absent as the smallest mesh size set was 3½ inches and this species may have been too small to be caught in this mesh.

Pike

Eight pike were taken in gill nets on July 3, 1967, most being caught in the 3½ inch mesh nets. All were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VIII).

Table VIII. Pike from Agar Lake
Number in Sample: 8

Age Class	n	♀♀	Fork Length (mm)			Weight (g)		
			$\bar{x}$	$S_{\bar{x}}$	range	$\bar{x}$	$S_{\bar{x}}$	range
V+	3	1	545		540-552	908		780- 985
VI+	5	3	577	±6.6	554-595	1256	±201	950-2045

The eight fish belonged to age class V and age class VI and would appear to have a moderate growth rate for this species. However, there does not appear to be a very large population of pike in this lake. There is not likely a very good potential for a sport fishery for this species.

Lake Whitefish

One hundred and thirteen lake whitefish were caught in gill nets on July 3, 1967, most being caught in the 4½ inch mesh nets (Table VII). Sixty of these were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table IX).

The fish sampled ranged in age from four to nine years, with age class VI being the most abundant in the catch. Age classes V, VII and VIII were also quite numerous. These fish must be very fast growing during their early years, as fish in age class V had an average fork length of 424 mm and an average weight of 1162 grams. After this, however, there was very little increase in fork length or weight, as fish in age class VIII had an average fork length of 447 mm and an average weight of 1289 grams. It may be noted that there was a great variation in sizes within each age class (Table IX).

Table IX. Lake Whitefish from Agar Lake, July 3, 1967.
Number in Sample: 60

Age Class	n	♀♀	Fork Length (mm) $\bar{x}$	Sx	range	Weight (g) $\bar{x}$	Sx	range
IV+	1	0	425			1160		
V+	14	2	424	± 4.3	385-445	1162	±29	915-1330
VI+	20	7	431	± 4.0	394-458	1208	±33	945-1520
VII+	11	4	430	± 6.2	412-465	1198	±51	920-1520
VIII+	10	3	447	±12.0	420-548	1289	±49	1050-1525
IX+	4	1	444	±14.7	402-465	1281	±68	1080-1380

All the fish examined were either mature or maturing so that they must mature at a relatively early age. The spawning habitat for this species is more than adequate. However, there may be some limitation on food supply due to the sparse bottom fauna, and this may be reflected in their slow growth rate after age class V.

Thirty lake whitefish were examined for plerocercoids of *Triaenophorus crassus*. Eleven (37%) were found infected with a total of 25 cysts. The total weight of the fish examined was 81 pounds, which gives an infestation rate of 31 cysts per 100 pounds of fish. This is low enough for these fish to be economically filleted and sold for human consumption on the commercial market.

DISCUSSION AND CONCLUSIONS

Agar Lake is so shallow as to be eutrophic, but edaphic factors, particularly the low level of dissolved nutrients in the water, tend to lower the productivity. The part of the lake that has a great many islands probably does not support a significant fish fauna.

The lake whitefish in the lake do have some commercial value, as their rate of infestation with *Triaenophorus crassus* is quite low. However, until this lake becomes more accessible, it is unlikely that this potential will be realized.

UNNAMED LAKE (107-4-W4th)

INTRODUCTION

This small unnamed lake is located about 135 miles northeast of Fort McMurray, Alberta and is inaccessible during the summer season except by float plane. The lake is situated in Township 107, Range 4, West of the Fourth Meridian. It has no inlets or outlets and the water level is probably maintained by ground water intrusion. The lake was surveyed between July 4 and July 9, 1967.

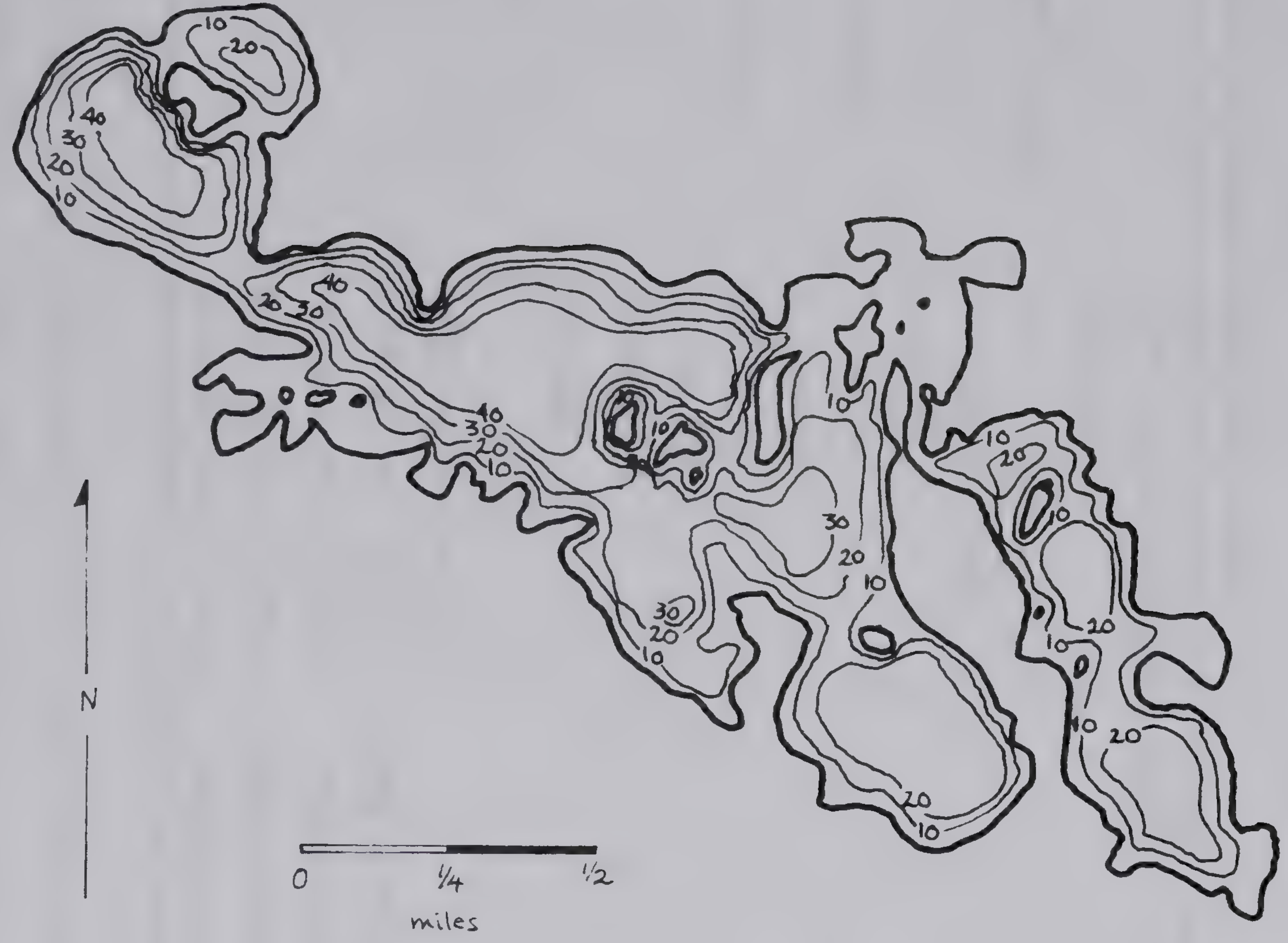
The surrounding country consists of sand ridges interspersed with muskeg. Small jack pine are growing on the sand ridges while much of the muskeg supports black spruce.

MORPHOMETRY

Depth were determined using an echo sounder and a contour map was constructed from the data obtained (Figure 1). The volume and depth distribution were determined from this map. All other morphometric data were obtained from planimetric maps at a scale of one inch to one mile.

The lake has a surface area of 1.03 square miles (659 acres). The length of the shoreline (including the shoreline of the islands) is 10.8 miles, giving a shoreline development factor of 3.0, which means that the shoreline is quite irregular and hence a large part of the lake is quite shallow. The maximum length of this lake is 2.5 miles, while the maximum effective length is only 1.1 miles and the maximum width is 1.5 miles. The maximum effective width is only 0.5 miles and the mean width 0.4 miles. These dimensions may limit the action of the wind

Figure 1. Contour map of Unnamed Lake (107-4-W. 4th M.).



on the lake and prevent it from driving the thermocline to very great depths. The volume of the lake is estimated to be in the order of 12,000 acre-feet, giving a mean depth of 18 feet. The maximum depth found was 45 feet. From the depth distribution (Table I) it can be seen that much of the lake is quite shallow and that only 19% is deeper than thirty feet.

Table I. Morphometry of Unnamed Lake (107-4-W4th)

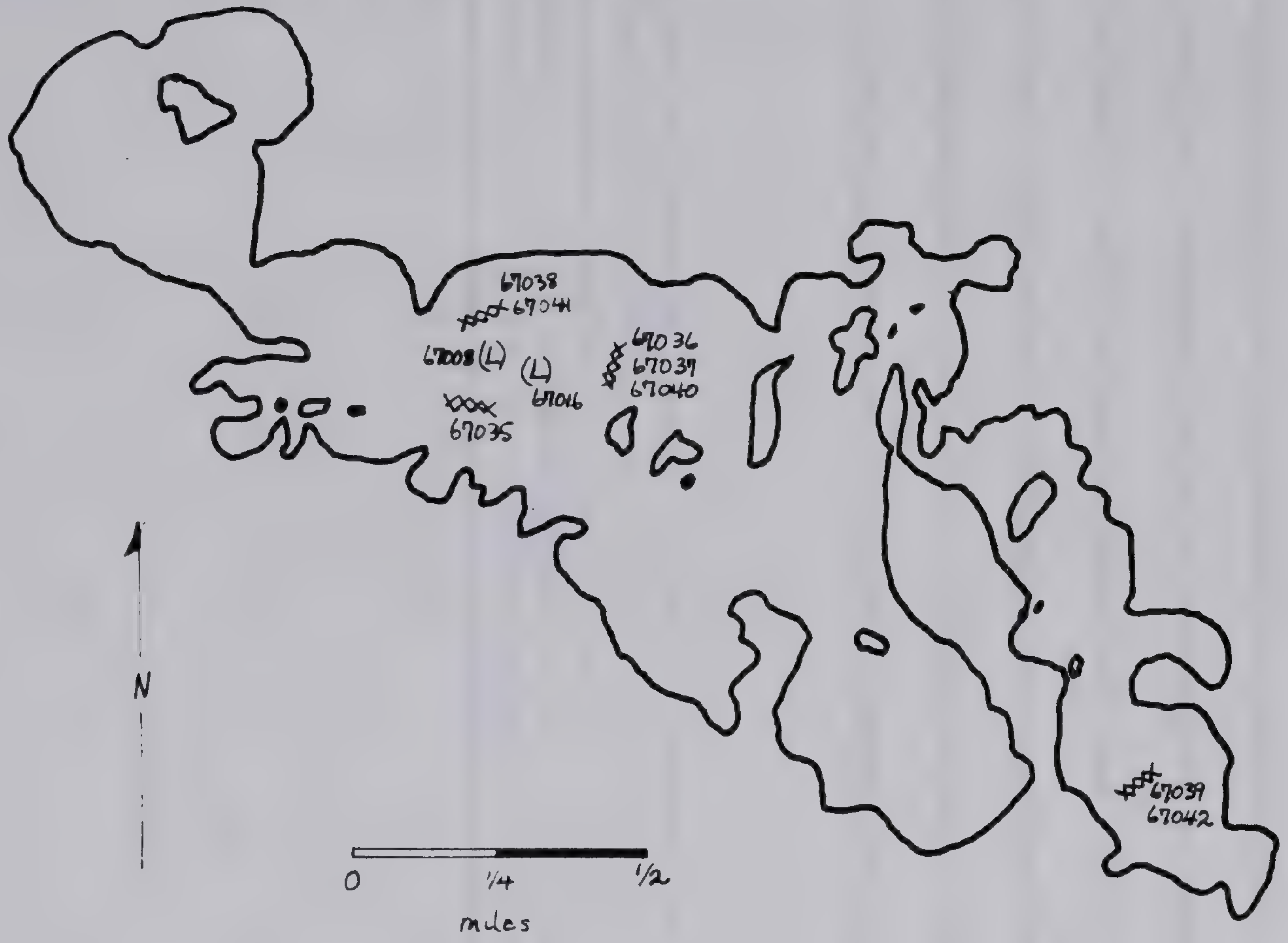
Area:	1.03 square miles (659 acres)	
Shoreline:	10.8 miles	
Shoreline development factor:	3.0	
Volume:	12,000 acre feet	
Maximum length:	2.5 miles	
Maximum effective length:	1.1 miles	
Maximum width:	1.5 miles	
Maximum effective width:	0.5 miles	
Mean width:	0.4 miles	
Maximum depth:	45 feet	
Mean depth:	18 feet	
Depth distribution:		
surface area:	1.03 sq. mi. (659 a.)	
10 feet plus:	0.68 sq. mi. (435 a.)	66% surface area
20 feet plus:	0.46 sq. mi. (292 a.)	44% surface area
30 feet plus:	0.20 sq. mi. (128 a.)	19% surface area
40 feet plus:	0.11 sq. mi. (70 a.)	10% surface area

The morphometry of this lake, particularly the low mean depth and high shoreline development, would indicate a eutrophic status.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made at station #67008 on July 8, 1967 at 5:00 p.m., the depth at the station being 44 feet(Figure 2).

Figure 2. Net sets (xxx) and limnology stations (L) on Unnamed Lake (107-4-W. 4th M.).



At this date the lake was thermally and chemically stratified (Table II). The thermocline was located between 25 and 36 feet, with the sharpest change occurring between 25 and 30 feet. The concentration of dissolved oxygen in the epilimnion and the thermocline was very high (90% saturation). There was some evidence of oxygen depletion in the hypolimnion, as the saturation level was only 60% at 42 feet. The pH in the epilimnion was 7.3, while it decreased to 7.2 at the thermocline and to 6.8 at 42 feet. This may indicate a moderate amount of decomposition occurring on the bottom of this lake. The high oxygen value and lower pH in the thermocline may indicate a fair amount of productivity by phytoplankton at this depth. The transparency of the water, as measured with a secchi disc, was 23 feet, so there were not very substantial amounts of plankton in the epilimnion.

Table II. Observations at Limnology Station #67008 on Unnamed Lake (107-4-W4th), July 8, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen		pH (Hellige)
		p.p.m.	% saturation	
0	16.5	9	90	7.3
5	16.5			
10	16			
15	15.5	9	90	7.3
20	15.5			
25	14			
30	11.5	10	90	7.2
33	10.5			
36	9			
40	8			
42	7.5	7	60	6.8
44	7			

A second series of observations was made at station #67016 on August 19, 1967 at 2:00 p.m., the depth at the station being 42 feet (Figure 2). The lake was thermally and chemically stratified (Table III). At this date the thermocline was located between 30 and 40 feet, the temperature being 17.5°C at 30 feet and decreasing to 19°C at 40 feet. The concentration of dissolved oxygen in the epilimnion was quite high, being from 90 to 95% saturation. Oxygen depletion in the hypolimnion had progressed further by this late date, the dissolved oxygen being at 45% saturation at 40 feet. The pH at the surface was 7.6+ but this had decreased to 7.6 at 30 feet and was 7.0 at 40 feet. These values are a marked increase over the values obtained on July 8, 1967. The lower pH at 40 feet, however, probably does represent a certain amount of decomposition occurring on the bottom, affecting the waters of the hypolimnion. The higher oxygen value and slightly lower pH just above the thermocline may be due to production of phytoplankton at this depth. The transparency of the water, as measured with a secchi disc, was 28 feet at this date, so there could not have been a very substantial amount of plankton in the epilimnion. The specific conductance ranged from 67 mmhos/cm (standardized to 18°C) at the surface to 80 mmhos/cm at 40 feet. This may represent a build up of dissolved nutrients in the hypolimnion.

Table III. Observations at Limnology Station #67016 on Unnamed Lake (107-4-W4th), August 19, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)	Conductance (mmhos/cm @ 18°C)
0	20	8	90	7.6+	67
5	19				
10	19				
15	18.5				
20	18.5				
25	18				
30	17.5	9	95	7.6	70
35	12.5				
40	10	5	45	7.0	80
42	9.5				

Water samples were taken at both stations and analyzed with a Hach kit, except for pH, which was determined with a Hellige color comparator and specific conductance, determined with a Bechman conductivity meter (Table IV).

Table IV. Water Chemistry, Unnamed Lake (107-4-W4th). Samples 67016 to 67019 were taken at Limnology Station #67008 and the others were taken at Limnology Station #67016.

Sample Number	67016	67017	67018	67019	67063	67064	67065
Depth (feet)	42	30	15	0	0	30	40
Temperature (°C)	7.5	11.5	15.5	16.5	20	17.5	10
Dissolved oxygen (p.p.m.)	7	10	9	9	8	9	5
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0	0	0	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	50	50	50	50	40	55	50
Calcium hardness (p.p.m. $CaCO_3$)	20	20	20	20	25	20	20
Total hardness (p.p.m. $CaCO_3$)	50	45	45	45	45	40	40
Chlorides (p.p.m.)	5	5	5	5	2.5	2.5	2.5
pH (Hellige)	6.8	7.2	7.3	7.3	7.6+	7.6	7.0
Conductance (mmhos/cm @ 18°C)	-	-	-	-	67	70	80

The alkalinity of the water was quite low as were the hardness values. The specific conductance varied from 67 to 80 mmhos/cm (standardized to 18°C), indicating a small quantity of dissolved nutrients in the lake.

The limnology of this lake indicates that this lake is quite unproductive considering its morphometry. This unproductive nature is probably due to unfavorable edaphic factors, particularly the low level of dissolved nutrients.

PLANKTON

Plankton samples were taken at each station on the lake. They were thirty foot vertical hauls with a Wisconsin type plankton net (mouth diameter of 20 cm). The samples were preserved and analyzed later in the laboratory, the organisms being classified and their relative abundance determined (Table V).

Table V. Plankton from Unnamed Lake (107-4-W4th). Sample 67008 was taken July 8, 1967 and Sample 67016 on August 19, 1967.

Organism	Relative abundance	
	Sample #67008	Sample #67016
Diatoms		
Asterionella	rare	abundant
Tabellaria	very abundant	rare
Blue-green algae		
Anabaena	rare	
Gloeotrichia		common
Dinoflagellates		
Ceratium	very abundant	common
Rotifers	very abundant	common
Crustaceans		
Copepods	very abundant	common
Cladocera	common	

The plankton was quite sparse at both times, but more so during August. The same major divisions were represented in both samples and the absence of green algae is noted. The phytoplankton did not consist of very many species and is certainly not typical of eutrophic lakes.

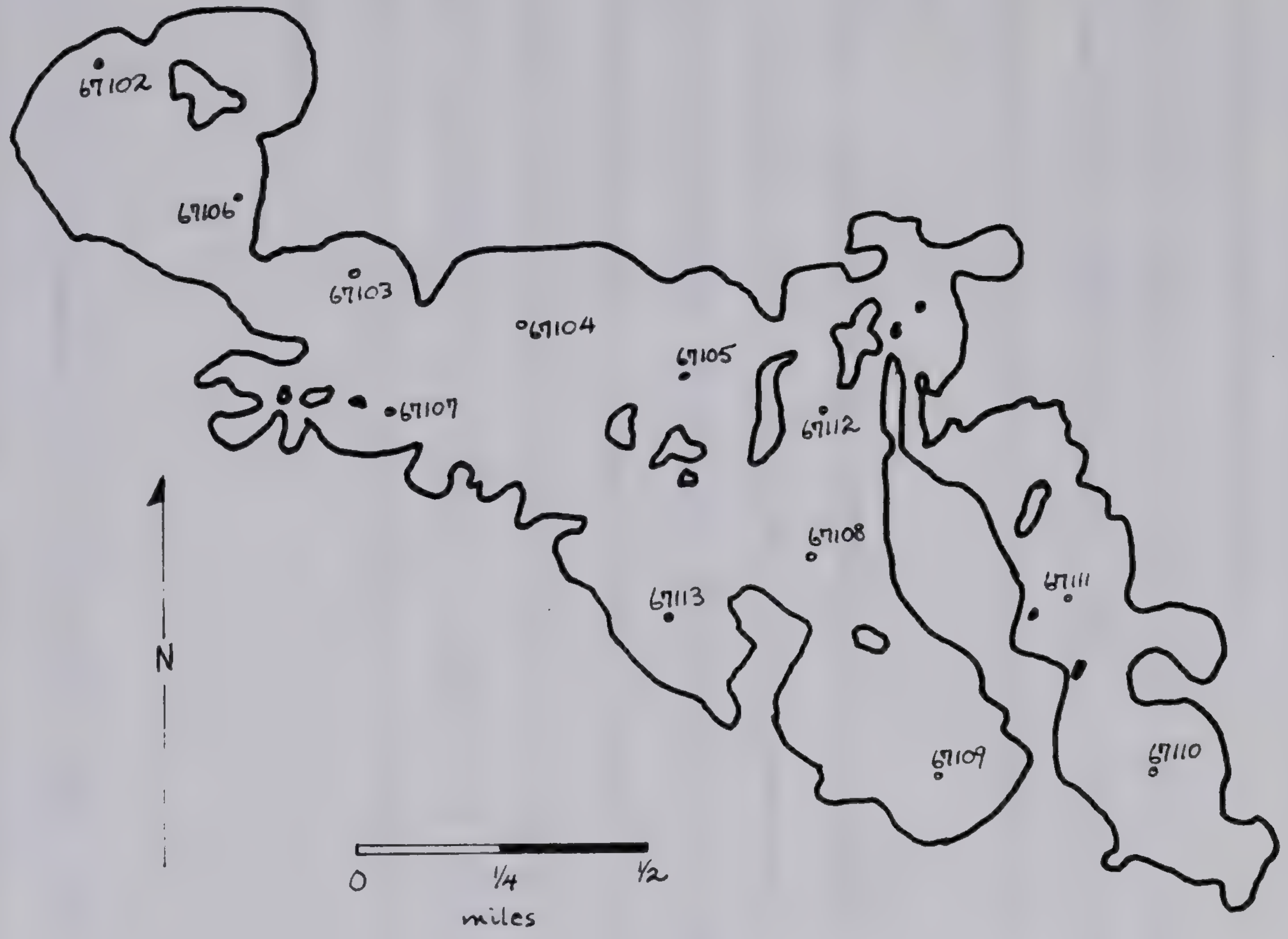
BOTTOM FAUNA

Twelve bottom samples were taken from this lake between July 4 and July 9, 1967 (Figure 3), each sample consisting of four hauls with a six inch square Ekman dredge. These were washed through a screen bottomed bucket (25 meshes per inch) and all living organisms preserved. These were classified, counted and their displaced volumes measured later in the laboratory (Table VI).

Table VI.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Amphipoda	Ephemeroptera	Trichoptera	Chironomidae	Other Diptera	Pelecypoda	Others	Total	Displaced Volume (cc)
67102	39	Muck	5	-	-	-	14	-	2	-	16	0.30
67103	43	Sand, muck	-	1	-	-	34	4	1	-	40	0.45
67104	43	Muck	1	-	-	-	1	2	-	-	4	0.05
67105	36	Sand, muck	-	-	-	-	37	6	-	-	43	0.35
67106	3	Sand	5	54	-	2	18	4	2	2	87	0.20
67107	7	Sand	20	62	7	6	40	-	-	21	156	0.60
67108	27	Muck	-	-	-	-	2	-	-	1	3	0.05
67109	29	Muck	-	-	-	-	7	-	-	2	9	0.20
67110	22	Muck	3	-	-	-	30	1	4	-	38	0.30
67111	29	Muck	-	-	-	-	5	4	3	-	12	0.10
67112	20	Muck	-	1	-	-	-	1	-	3	5	0.05
67113	21	Muck	-	-	1	-	1	2	-	2	6	0.05
Average/square meter			26	106	7	7	170	22	11	26	376	2.42
Percent of total number			7	28	2	2	45	6	3	7		

Figure 3. Bottom sampling stations on Unnamed Lake (107-4-W. 4th M.).



From the bottom samples it can be seen that most of the lake bottom consists of sand or muck. There were also some fairly large areas of gravel and rubble, but these could not be sampled with an Ekman dredge. The sand was found as deep as 43 feet (Table VI) and muck was found as shallow as twenty feet. The organic muck in this lake appears to be well decomposed. Most of the shoreline was of sand or gravel and there was very little evidence of rooted aquatic plants.

An average of 376 organisms per square meter with a displaced volume of 2.42 cc per square meter was found. This is quite poor and may place some limitations on a population of bottom feeding fish such as lake whitefish.

The dominant organisms in the samples were chironomids, making up 45% of the total number of organisms. The second most abundant organisms were amphipods, comprising 28% of the total number of organisms, although they were only found in four samples. Oligochaetes, found in four samples, made up 7% of the total number of organisms and most other organisms were quite insignificant in number and volume.

The bottom fauna sampled on this lake would indicate this lake is quite unproductive.

FISH FAUNA

Test nets were set between July 4 and July 9, 1967. Nets set included 2½, 3½, 4½ and 5½ inch mesh size. All nets were 50 yards in length except the 2½ inch mesh net, which was 100 yards in length (Figure 2). Fish caught included pike (_Esox lucius_), lake trout (_Salvelinus namaycush_) and lake whitefish (_Coregonus clupeaformis_) (Table VII).

From the test net results it would appear that the most abundant fish in the lake is lake whitefish. Pike also appear to be quite abundant, but the lake trout are not numerous. No tullibee were caught, but this does not mean they are absent in this lake. Many of our northern lakes have very small tullibee, and if this is the case, our smallest mesh (2½ inch) could have been too large to catch them.

In general, the catches in this lake were very poor and this may reflect the unproductive nature of the lake.

Table VII. Test Net Results, Unnamed Lake (107-4-W4th)

Net Set No.	Depth (feet)	Mesh Size (ins)	Pike	Lake Whitefish	Lake Trout	Total
67035	40	3½	4	3	-	7
67035	40	4½	4	10	-	14
67035	40	5½	-	7	-	7
67036	40	3½	1	6	1	8
67036	40	4½	3	5	-	8
67036	40	5½	-	5	-	5
67037	40	3½	7	3	-	10
67037	40	4½	1	6	-	7
67037	40	5½	1	4	-	5
67038	40	2½	2	3	-	5
67039	20	3½	3	2	-	5
67039	20	4½	1	5	-	6
67039	20	5½	-	-	-	-
67040	40	3½	4	2	-	6
67040	40	4½	-	4	1	5
67040	40	5½	-	4	-	4
67041	40	2½	3	5	-	8
67042	20	3½	2	1	-	3
67042	20	4½	3	4	-	7
67042	20	5½	-	-	-	-
		Totals	39	79	2	120

Pike

Thirty-nine pike were caught in gill nets between July 4 and July 9, 1967. Thirty-four of these were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VIII).

The pike in the sample ranged from three to nine years of age with fish in age class V being the most abundant. They appear to have quite a good growth rate, the fish in age class IX having an average fork length of 954 mm and an average weight of 6605 grams. It may be noted that they are very variable in size within all the age classes (Table VIII).

Table VIII. Pike from Unnamed Lake (107-4-W4th).
Number in Sample: 34

Age Class	n	♀♀	Fork Length (mm)			Weight (g)		
			$\bar{x}$	Sx	range	$\bar{x}$	Sx	range
III+	1	0	370			400		
IV+	4	4	485	±12.4	452- 512	765	± 43	660- 860
V+	12	9	595	± 8.1	565- 665	1448	± 59	1110-1920
VI+	6	5	622	±24.1	574- 735	1595	±215	1300-2640
VII+	4	4	694	± 0.5	693- 695	2020	± 36	1960-2100
VIII+	5	5	851	±42.4	722- 926	4334	±791	2100-6000
IX+	2	1	954		888-1020	6605		5500-7710

The pike in this lake are quite early maturing, as all those in age class IV were mature or maturing at the time of the survey. There is adequate spawning habitat for this species. There is, however, little cover but they appear to be doing quite well. They are probably utilizing the lake whitefish as a forage species.

This species, due to its large size and fast growth rate in this lake, offers a good potential for a sport fishery.

Lake Trout

Two lake trout were taken. Both were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination.

One was in age class VII, had a fork length of 542 mm and a weight of 1860 g and was a mature female. The other was in age class VIII and had a fork length of 652 mm, a weight of 3400 g and was a mature male. This represents a good growth rate for this species.

The spawning habitat is quite adequate in this lake, but the summer habitat is very restricted, as the area below 40 feet is very small. This species will disappear from this lake within a short time, as the lake continues to eutrophicate.

Lake Whitefish

Seventy-nine lake whitefish were taken. Sixty-four were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination. (Table IX).

Table IX. Lake Whitefish from Unnamed Lake (107-4-W4th)
Number in Sample: 64

Age Class	n	♀♀	Fork Length (mm)			Weight (g)		
			$\bar{x}$	$S_{\bar{x}}$	range	$\bar{x}$	$S_{\bar{x}}$	range
VI+	5	2	383	±10.2	355-410	823	± 81	600-1025
VII+	15	12	403	± 5.8	374-446	958	± 50	700-1360
VIII+	21	15	446	± 9.8	382-541	1395	±145	700-3200
IX+	12	3	440	±12.5	406-530	1386	±174	980-2880
X+	5	2	502	±29.8	417-560	2086	±397	1060-2890
XI+	3	2	493		475-510	1797		1610-1900
XII+	1	1	551			2740		
XIII+	2	1	525		512-538	2360		2020-2700

The fish in the sample ranged from six to thirteen years of age, and it would appear as though these fish have a moderate growth rate. The dominant age class in the sample was VIII, and age classes VII and IX were also quite numerous. It may be noted that there is a great variation in size within the age classes.

All the fish examined were mature, so that they must mature before age class VI. The spawning habitat in this lake is more than adequate for the species. However, the bottom fauna is quite poor, and may limit the size of this population, particularly of larger fish.

Thirty-five lake whitefish were examined for plerocercoids of Triaenophorus crassus. Twenty (57%) were found infested with a total of 113 cysts. The total weight of the thirty-five fish was 116 pounds, which gives an infestation rate of 97 cysts per 100 pounds of fish. This is too high for these fish to be of much value on the commercial market.

DISCUSSION AND CONCLUSIONS

Although the morphometry of this unnamed lake would indicate a relatively eutrophic condition, all other parameters measured indicate that the lake is quite unproductive.

The pike offer some potential for a sport fishery as a result of their good growth rate and large size, but the lake trout are probably disappearing from this lake and do not offer much potential for a fishery. The lake whitefish are too highly infested with the pike-whitefish tapeworm to be of much value.

Until this lake becomes more accessible, the potential it has for fisheries will not be realized.

RENE LAKE (104-1-W4th)

INTRODUCTION

Rene Lake is a small lake about 145 miles northeast of Fort McMurray, Alberta and is inaccessible during the summer except by float plane. It is located in Township 104, Range 1, West of the Fourth Meridian. It has no streams entering it but is drained by an unnamed stream which is a tributary to the Old Fort River. The lake was surveyed between July 9 and July 16, 1967.

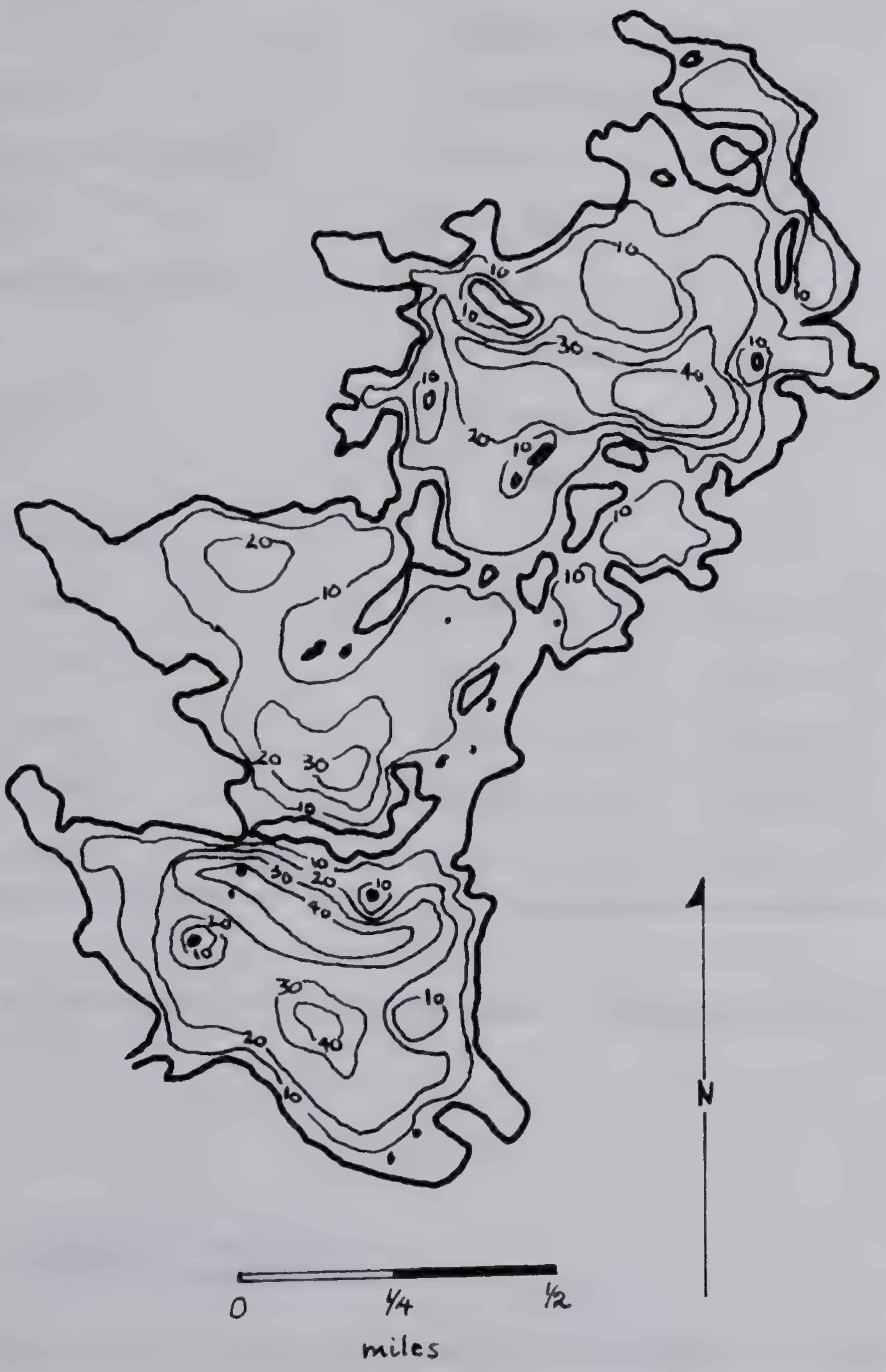
The surrounding country consists of sand or gravel ridges which have jack pine growing on them, interspersed with muskeg, much of which supports black spruce.

MORPHOMETRY

Depths were determined using an echo sounder. A contour map was constructed from these data (Figure 1) and this was used to determine depth distribution and volume. Other morphometric data was obtained from planimetric maps at a scale of one inch to one mile.

The surface area of Rene Lake is 0.98 miles and the length of the shoreline (including the shoreline of 27 islands) was 11 miles, which gives a shoreline development factor of 3.0, which means that the shoreline is quite irregular. The volume was estimated to be in the order of 7,500 acre feet, giving a mean depth of 12 feet. The maximum depth found was 45 feet. The maximum length of the lake is 1.8 miles while the maximum effective length is only 0.8 miles. The maximum width of Rene Lake is 0.8 miles while the maximum effective width is 0.7 miles and the mean width is 0.5 miles. With dimensions like these and the large

Figure 1. Contour map of Rene Lake.



number of islands in the lake, the wind does not have much chance to mix the lake waters. The depth distribution (Table I) shows that most of the lake is quite shallow, with only 37% being deeper than ten feet.

Table I. Morphometry of Rene Lake

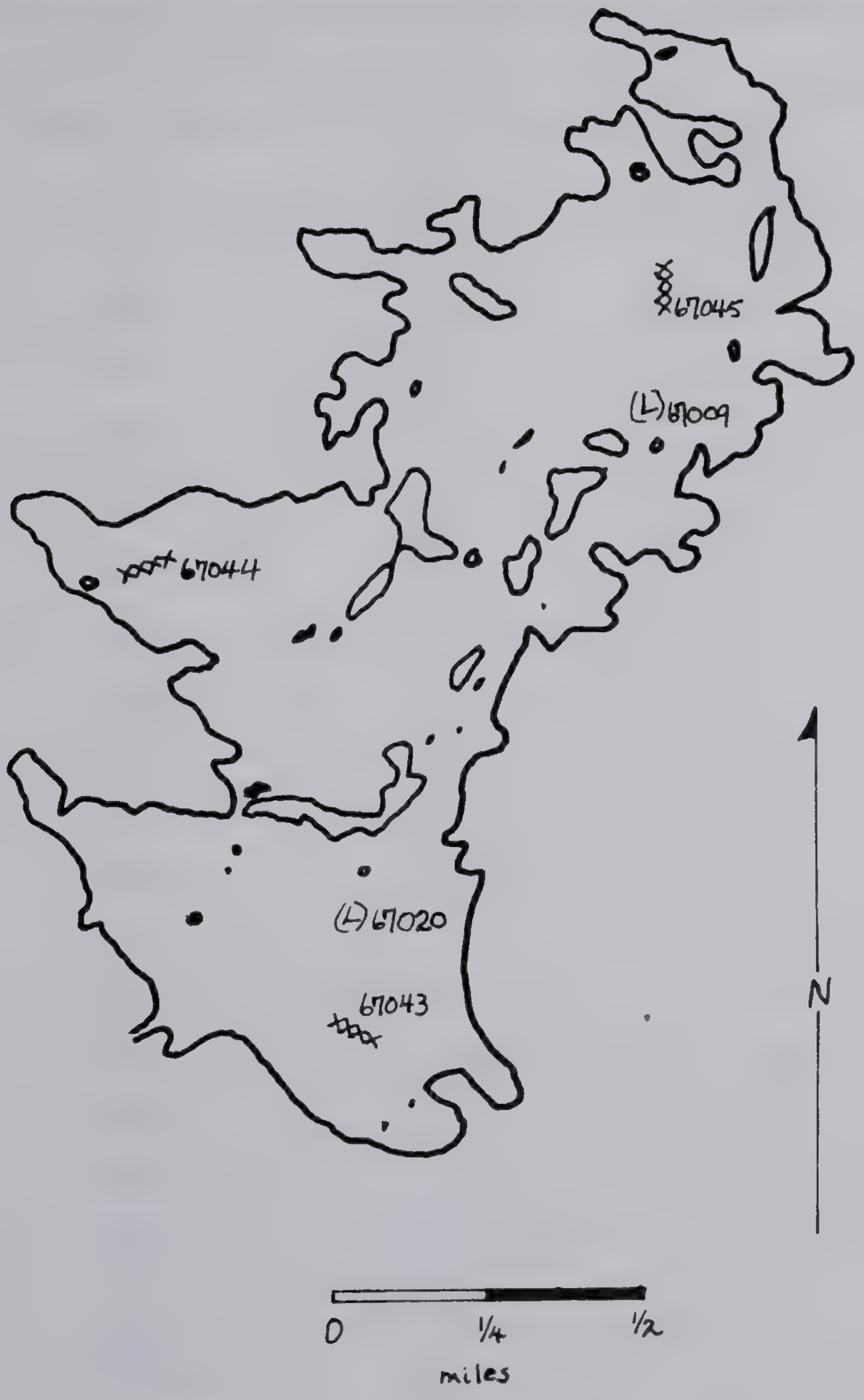
Area:	0.98 square miles (627 acres)	
Shoreline:	11.0 miles	
Shoreline development factor:	3.0	
Volume:	7,500 acre feet	
Maximum length:	1.8 miles	
Maximum effective length:	0.8 miles	
Maximum width:	0.8 miles	
Maximum effective width:	0.7 miles	
Mean width:	0.5 miles	
Maximum depth:	45 feet	
Mean depth:	12 feet	
Depth distribution:		
surface area:	0.98 sq. mi. (627 a.)	
10 feet plus:	0.36 sq. mi. (230 a.)	37% surface area
20 feet plus:	0.25 sq. mi. (160 a.)	25% surface area
30 feet plus:	0.08 sq. mi. (51 a.)	8% surface area
40 feet plus:	0.04 sq. mi. (26 a.)	4% surface area

The morphometry of Rene Lake indicates that it could be very eutrophic.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made at station #67009 on Rene Lake on July 15, 1967 at 3:00 p.m. (Figure 2). The depth at the station was 38 feet, and thermal and chemical stratification was evident at the time. The thermocline was located between 18 and 28 feet. In the epilimnion, the dissolved oxygen concentration was high, being from 75

Figure 2. Net sets (xxxx) and Limnology station (L) on Rene Lake.



to 85% saturation. At the thermocline, however, the dissolved oxygen concentration had dropped to 50% saturation, increasing to 65% saturation in the hypolimnion. This same type of distribution (orthograde) was evident in the pH also (Table II) as the pH was 6.9 in the epilimnion, 6.0 in the thermocline, and 7.0 in the hypolimnion. Transparency, as measured with a secchi disc, was 17 feet.

Table II. Observations at Limnology Station #67009 on Rene Lake, July 15, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)
0	18	8	85	6.9
5	18			
10	18			
15	18	7	75	6.9
18	17.5			
19	16			
20	15			
21	14.5			
22	14			
23	13.5			
24	12.5			
25	11			
26	9.5			
27	9	6	50	6.0
28	8.5			
29	8			
30	8			
31	7.5			
32	7.5			
33	7			
35	7			
37	7	8	65	7.0
38	6			

A second series of observations was made at station #67021 on August 19, 1967 at 5:00 p.m. (Figure 2). The depth at this station was 32 feet and chemical and thermal stratification were evident. The thermocline was located between 20 and 30 feet. At the surface, the dissolved oxygen concentration was 100% saturation but was only 35% saturation at 30 feet. The pH was 7.1 at the surface and only 6.0 at 30 feet. This may be evidence of a certain amount of decomposition occurring on the bottom of this lake (Table III). Transparency, as determined with a secchi disc, was 16 feet.

Table III. Observations at Limnology Station #67020 on Rene Lake, August 19, 1967.

Depth (feet)	Temperature (^{o}C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)
0	20	9	100	7.1
5	19			
10	18			
15	18			
20	17.5			
25	12.5			
30	9.5	4	35	6.0
32	9			

Water samples were taken at the limnology stations on Rene Lake on July 15 and August 19, 1967. These were analyzed with a Hach kit, except for pH, which was determined with a Hellige color comparator and specific conductance, which was measured with a Beckman conductivity meter.

This water showed very low alkalinity values (as p.p.m. calcium carbonate) and also very low calcium and total hardness values. The pH was neutral or slightly acidic and the specific conductivity was very low, ranging from 13 to 15 mmhos/cm (standardized to 18°C) (Table IV).

Table IV. Water Chemistry, Rene Lake. Samples 67023 to 67026 were taken at Limnology Station #67009 while the other two were taken at Limnology Station #67020.

Sample Number	67023	67024	67025	67026	67074	67075
Depth (feet)	37	27	15	0	0	30
Temperature (°C)	7	9	18	18	20	9.5
Dissolved oxygen (p.p.m.	8	6	7	8	9	4
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0	0	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	5	10	10	5	15	10
Calcium hardness (p.p.m. $CaCO_3$)	5	5	5	5	5	5
Total hardness (p.p.m. $CaCO_3$)	5	5	5	5	5	5
Chlordies (p.p.m.)	7.5	7.5	7.5	7.5	12.5	5
pH (Hellige)	7.0	6.0	6.9	6.9	7.1	6.0
Specific conductance (mmhos/cm @ 18°C)	-	-	-	-	13	15

Both the limnological observations and water chemistry of this lake indicate that it is very unproductive, considering its morphometry.

PLANKTON

Plankton samples were taken at each station, and were 30 foot vertical hauls with a Wisconsin-type plankton net, (mouth diameter of 20 cm). These samples were preserved and in the laboratory the organisms were classified and their relative abundance determined (Table V).

The transparency at both limnology stations was quite low, being 16 and 17 feet. However, this reduction in transparency was not due to an abundance of plankton, but rather to the color of the water, which had a slight brown tint to it. The plankton itself was quite sparse, in both hauls.

Table V. Plankton from Rene Lake. Sample 67009 was taken on July 15, 1967 and Sample 67020 was taken on August 19, 1967.

Organism	Relative abundance	
	Sample #67009	Sample #67020
Blue-green algae		
Anabaena	very abundant	common
Deborya	rare	
Diatoms		
Asterionella		common
Dinoflagellates		
Ceratium		rare
Rotifers	common	abundant
Crustaceans		
Copepods	very abundant	common
Cladocerans	rare	abundant

The phytoplankton appeared to be dominated by blue-green algae and there was a notable lack of diatoms (other than *Asterionella*) in the samples. The plankton is not typical of a eutrophic lake, and does not indicate a high degree of productivity.

BOTTOM FAUNA

Ten bottom samples were taken between July 9 and July 16, 1967 (Figure 3). Each sample consisted of four hauls with a six inch square Ekman dredge, and these were washed through a screen bottomed bucket, (25 meshes per inch) and all living organisms preserved. These were classified later in the laboratory, counted, and their displaced volumes measured (Table VI).

Figure 3. Bottom sampling stations on Rene Lake.

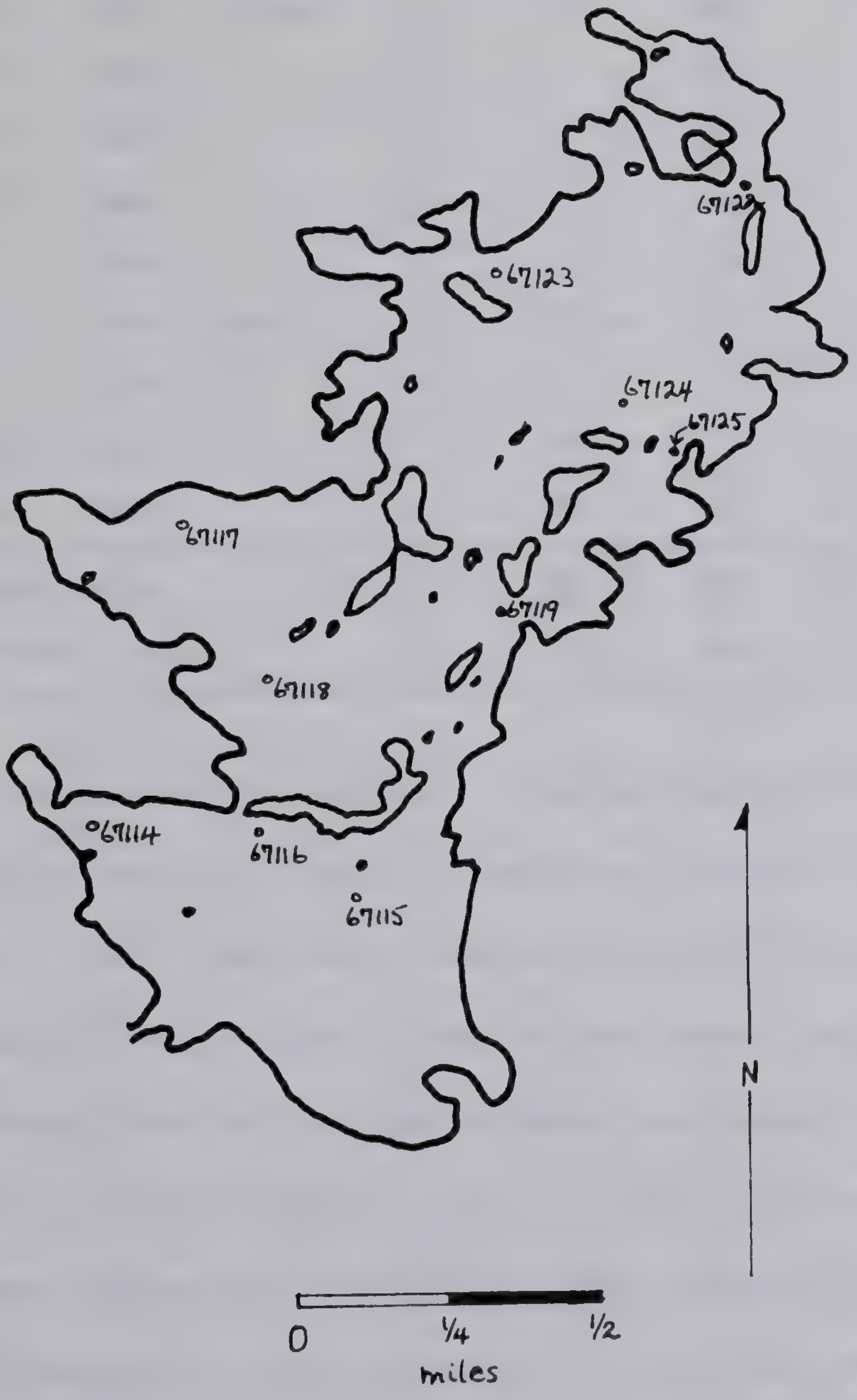


Table VI. Bottom Fauna from Rene Lake, July 9 to July 16, 1967.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Hirudinea	Amphipoda	Ephemeroptera	Chironomidae	Other Diptera	Pelecypoda	Others	Total	Displaced Volume (cc)
67114	10	Muck, detritus	1	-	4	-	12	-	5	1	23	0.15
67115	25	Muck, gravel	3	-	-	-	49	-	3	-	55	0.60
67116	25	Muck	-	-	-	-	50	-	-	-	50	0.15
67117	22	Muck	-	-	-	-	1	-	-	-	1	0.15
67118	18	Muck	1	-	-	-	5	-	-	-	6	0.05
67119	15	Muck	-	-	-	-	25	-	1	-	26	0.05
67022	15	Sand, muck	-	-	13	6	35	-	1	1	56	0.15
67123	10	Muck	1	-	2	-	2	-	-	2	7	0.05
67124	46	Muck	1	-	-	-	12	-	-	-	13	0.15
67125	3	Sand	7	3	40	-	21	4	10	1	86	0.35
Average/square meter			15	3	63	6	228	4	22	5	348	1.88
Percent of total number			4	1	20	2	66	1	7	2		

From the bottom samples it can be seen that much of the lake bottom consists of organic muck or detritus and sand or gravel. The organic muck in this lake had a reddish color to it and was not very well decomposed in most cases. Much of the shoreline was of sand or gravel, although some of the lake bordered on muskeg. There was not much evidence of rooted aquatic plants in the lake, and this probably tends to lower the production of fish food organisms.

An average standing crop of 348 organisms per square meter was found, with a volume displacement of 1.88 cc per square meter. This is quite sparse and may place limitations on a population of bottom feeding fish, such as lake whitefish.

Chironomids dominated the bottom samples, being found in all the samples and comprising 66% of the total number of organisms. Amphipods were next in abundance, being found in 40% of the samples and making up 20% of the total number of organisms. Other organisms found were insignificant in both numbers and volume and probably do not contribute much to the bottom fauna of this lake.

FISH FAUNA

Three test net sets were made on July 10 and lifted on July 11, 1967. Mesh sizes used included 2½, 3½, 4½ and 5½ inch and all nets were 50 yards in length, except the 2½ inch mesh net which was 100 yards in length (Figure 2). Fish caught included pike (Esox lucius) and lake whitefish (Coregonus clupeaformis)(Table VII).

Table VII. Test Net Results, Rene Lake, July 11, 1967.

Net Set No.	Depth (feet)	Mesh Size (ins)	Pike	Lake Whitefish	Total
67043	15	3½	1	3	4
67043	20	4½	-	8	8
67043	25	5½	-	4	4
67044	8	2½	11	19	30
67045	10	3½	3	7	10
67045	15	4½	2	13	15
67045	20	5½	-	3	3
	Totals		17	57	74

No tullibee were caught in the nets, but they may be present and just too small to be caught in the 2½ inch mesh nets, which were the smallest set. It would appear from the test nets that lake whitefish are the most numerous species in the lake, and that pike are the only predaceous species in the lake.

Pike

Seventeen pike were taken. All of these fish were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VIII).

Table VIII. Pike from Rene Lake, July 11, 1967.
Number in Sample: 17

Age Class	n	♀♀	Fork Length (mm) $\bar{x}$	Fork Length (mm) $S_{\bar{x}}$	Fork Length (mm) range	Weight (g) $\bar{x}$	Weight (g) $S_{\bar{x}}$	Weight (g) range
IV+	8	4	504	±16.0	447-565	847	±60	630-1060
V+	9	2	528	± 7.7	499-571	947	±57	740-1340

The fish belonged to age classes IV and V and were all mature at this time. They appear to grow quite rapidly in length, but appear very thin and have poor weights for their lengths. Fish in age class V had an average fork length of 528 mm and an average weight of only 947 grams. It is possible that these fish are suffering from over population with the large shallow areas and little in the way of forage fish other than lake whitefish.

The spawning habitat for this species in Rene Lake is more than adequate, but there may be restriction on the food supply.

Lake Whitefish

Fifty-seven lake whitefish were taken. Fifty-two of these fish were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table IX).

Table IX. Lake Whitefish from Rene Lake, July 11, 1967.
Number in Sample: 52

Age Class	n	♀♀	Fork Length (mm) $\bar{x}$	Sx	range	Weight (g) $\bar{x}$	Sx	range
IV+	1	-	254			200		
V+	2	-	285		276-293	298		265- 330
VI+	5	3	392	±10.4	365-428	883	± 94	725-1210
VII+	20	15	400	± 5.0	359-441	905	± 31	680-1240
VIII+	19	7	409	± 4.6	376-457	953	± 25	795-1210
IX+	4	2	459	±15.8	420-495	1079	±106	860-1340
X+	1	0	459			1160		

The fish in the sample ranged from four to ten years in age and the dominant age classes in the sample were VII and VIII. All fish beyond age class VI were mature and would spawn in the fall. The spawning habitat for this species in Rene Lake is more than adequate.

Lake whitefish in this lake seem to have a poor growth rate, as fish in age class VIII had an average fork length of 409 mm and an average weight of 953 grams. There does not appear to be much growth beyond age class VI, as there was little increase from that age class to age class VIII. This may reflect the paucity of bottom organisms in the lake.

Thirty of the lake whitefish were examined for plerocercoids of Triaenophorus crassus. Twenty-six (87%) were found infested with a total of 500 cysts. The total weight of the sample was 65 pounds, which gives an infestation rate of about 800 cysts per 100 pounds of fish. This is far to high for these fish to be of value on the commercial market.

DISCUSSION AND CONCLUSIONS

Even though the morphometry of this lake points toward eutrophy, all other indicators would lead one to believe that this lake is very unproductive. The limnological observations did not reveal that much decomposition was occurring on the bottom, although at the thermocline there was oxygen depletion. The water chemistry would indicate that there is very little dissolved nutrients in the water and the bottom fauna was quite sparse.

The pike are too small to be of much value for a sport fishery at present and the lake whitefish are too heavily infested with the pike-whitefish tapeworm to be of any value on the commercial market.

UNNAMED STREAM DRAINING RENE LAKE

This small stream, which drains Rene Lake, is a tributary of Old Fort River, and was examined at the point where it leaves Rene Lake on July 12, 1967.

The mean width of the stream at this location was about 12 feet and the mean depth was about one foot. The stream had a moderate flow, being quite fast through some of the riffle areas. The pools were small and infrequent. The bottom of the stream was of gravel and rubble in the riffles, with sand and mud in the pools. There was little aquatic vegetation except along the bank.

The immediate shore was covered with Ledum, Salix and Carex, and cover was good. The water temperature was 18°C at this time.

Rotenone was used to obtain samples of the species of fish present. These included pike (Esox lucius), burbot (Lota lota) and perch (Perca flavescens).

This stream does not appear to have much value as a fishery.

UNNAMED LAKE (103-5-W4th)

INTRODUCTION

This small unnamed lake is situated about 110 miles northeast of Fort McMurray, Alberta and is inaccessible during the summer except by float plane. It is located in Township 103, Range 5, West of the Fourth Meridian and is drained by a small stream, although there are no streams entering the lake. The small stream is a tributary to the Richardson River, which flows into the Athabasca delta. The lake was surveyed between July 16 and July 20, 1967.

The surrounding area consists of sand ridges covered with small jack pine or muskeg with black spruce. Outcroppings of the Precambrian Shield were noticed in this area also.

MORPHOMETRY

Depths were determined using an echo sounder (Figure 1) and a contour map was constructed from the data obtained. Volume and depth distribution were determined from this map while most other morphometric data came from planimetric maps at a scale of one inch to one mile.

The area of this unnamed lake is 1.28 square miles (819 acres). The length of the shoreline is 8.2 miles, which gives a shoreline development factor of 2.0, which means that the shoreline is moderately irregular (Table I). The maximum length of the lake is 2.9 miles while the maximum effective length is 2.1 miles. The maximum width of the lake is 0.7 miles, as is the maximum effective length, while the mean width is 0.4 miles. With these dimensions, the wind should mix the waters of this lake quite well.

Figure 1. Contour map of Unnamed Lake (103-5-W. 4th M.).

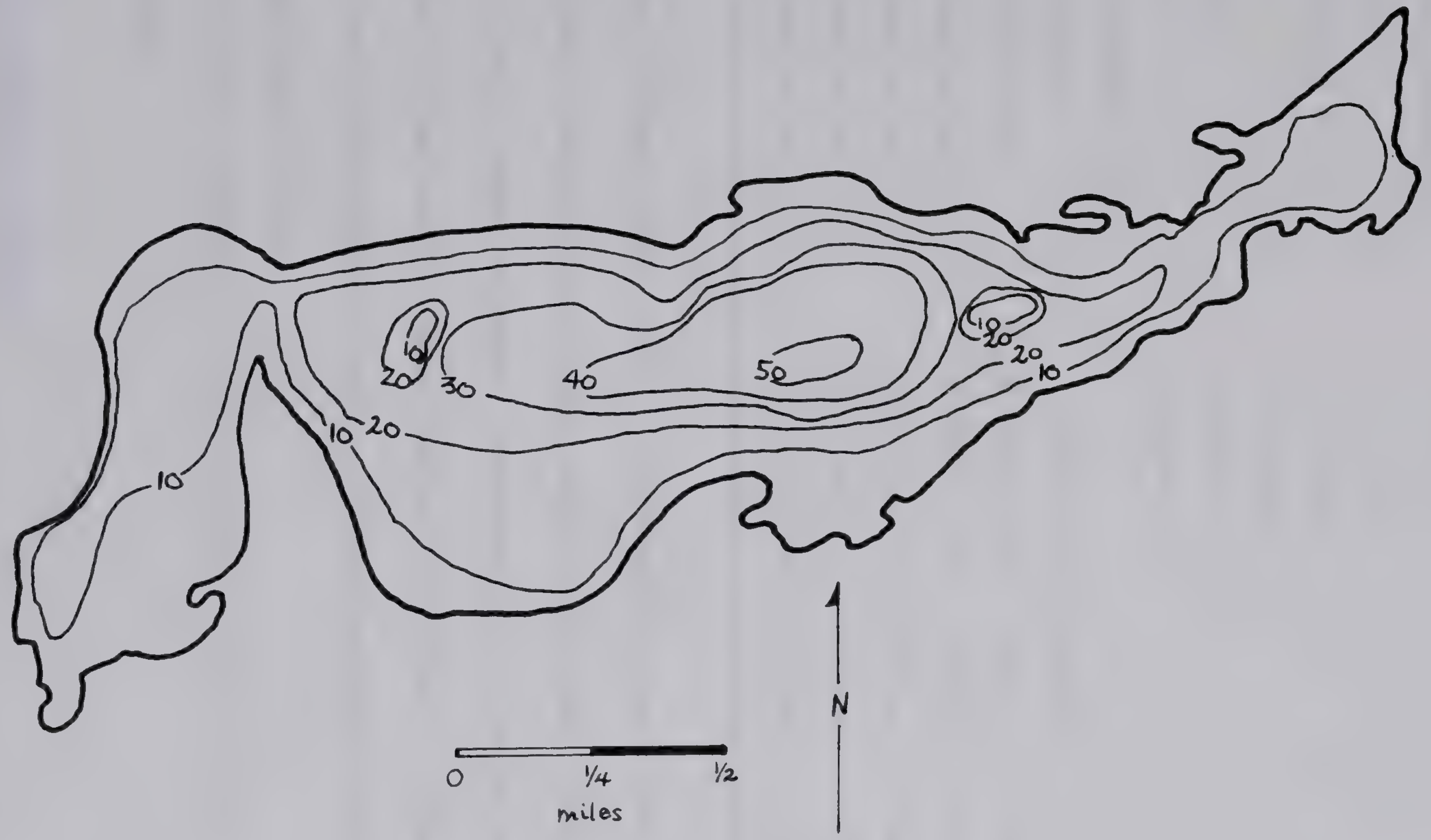


Table 1. Morphometry of Unnamed Lake (103-5-W4th)

Area:	1.28 square miles (819 acres)	
Shoreline	8.2 miles	
Shoreline development factor:	2.0	
Volume:	13,500 acre feet	
Maximum length:	2.9 miles	
Maximum effective length:	2.1 miles	
Maximum width:	0.7 miles	
Maximum effective width:	0.7 miles	
Mean width:	0.4 miles	
Maximum depth:	55 feet	
Mean depth:	16 feet	
Depth distribution:		
surface area:	1.28 sq. mi. (819 a.)	
10 feet plus:	0.80 sq. mi. (512 a.)	62% surface area
20 feet plus:	0.40 sq. mi. (256 a.)	31% surface area
30 feet plus:	0.20 sq. mi. (128 a.)	16% surface area
40 feet plus:	0.11 sq. mi. (70 a.)	9% surface area
50 feet plus:	0.01 sq. mi. (6 a.)	1% surface area

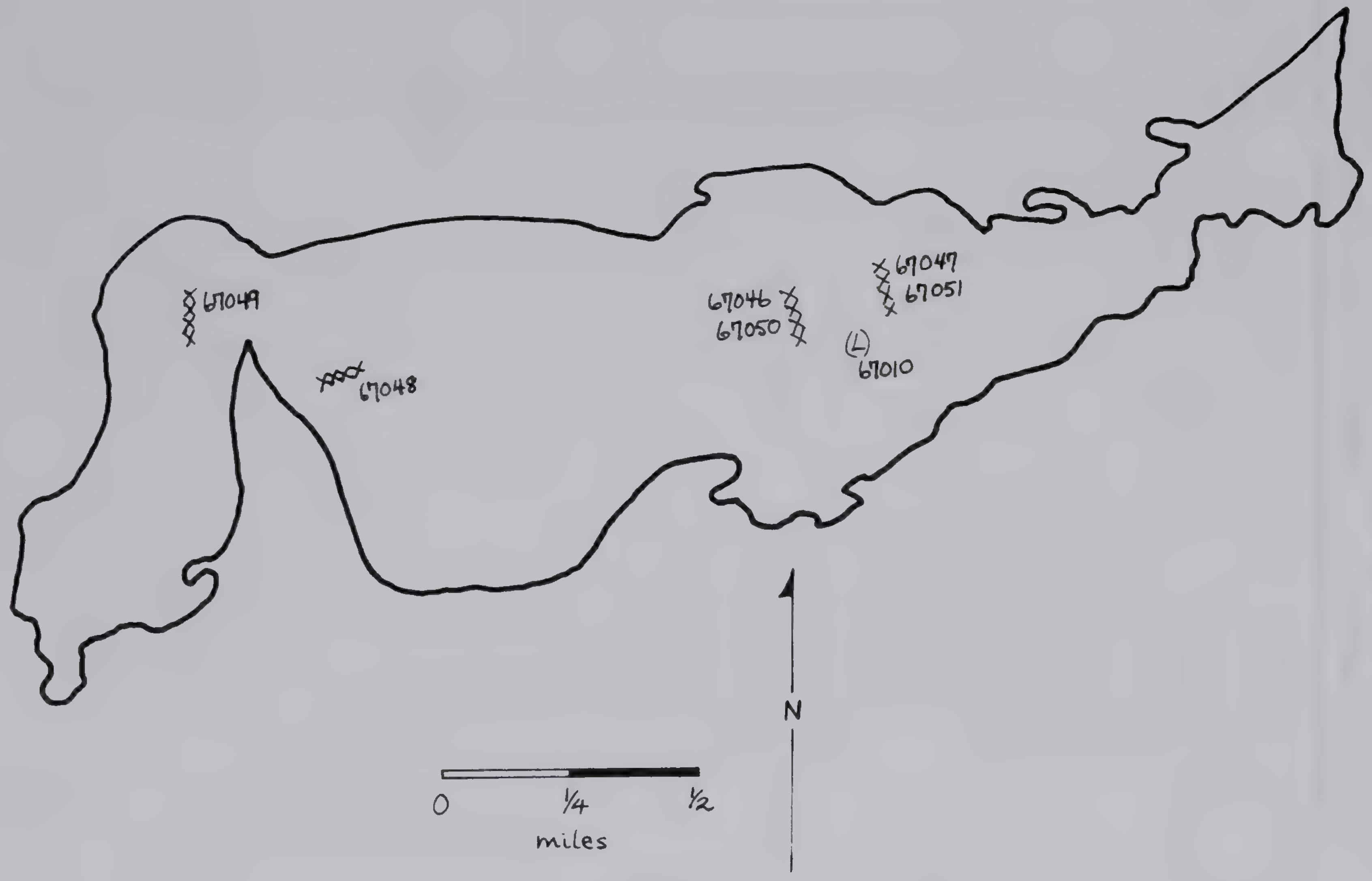
The volume of this lake is estimated to be in the order of 13,500 acre feet, which gives a mean depth of 16 feet. The maximum depth found was 55 feet. From the depth distribution it can be seen that a large portion of the lake is very shallow (less than 10 feet) and that only 31% of the surface area is below 20 feet and only 16% of the surface area is deeper than 30 feet.

From the morphometry of this lake we could expect it to be quite eutrophic.

PHYSICAL AND CHEMICAL FEATURES

Limnological observations were made at station #67010 on

Figure 2. Nets sets (xxx) and limnology station (L) on Unnamed Lake (103-5-W. 4th M.).



July 19, 1967 at 5:00 p.m. (Figure 2). The depth at the station was 50 feet and thermal and chemical stratification was evident at this time (Table II).

Table II. Observations made at Limnological Station #67010 on Unnamed Lake (103-5-W4th), July 19, 1967.

Depth (feet)	Temperature (°C)	Dissolved oxygen p.p.m.	Dissolved oxygen % saturation	pH (Hellige)
0	21	9	100	7.6+
5	21			
10	21	10	110	7.6+
15	20.5			
16	19			
17	18.5			
18	18			
20	18	11	115	7.6+
22	18			
24	17.5			
25	17.5	12	120	7.6+
26	17			
27	16.5			
28	15.5			
29	14.5			
30	13	10	95	7.6+
31	12.5			
32	12.5			
33	11.5			
34	11			
35	11			
40	8.5	3	25	7.5
42	8			
44	8			
46	7			
48	7			
50	6.5			

The thermocline was situated between about 25 and 40 feet, the temperature changing from 17.5°C at 25 feet to 8.5°C at 40 feet. The dissolved oxygen in the epilimnion was above saturation level, being from 100% saturation to 120% saturation at 25 feet. This may be due to a large number of phytoplankters present in the water on this date. The dissolved oxygen in the thermocline was at 95% saturation while in the hypolimnion (at 40 feet) it had been reduced to 25% saturation. The pH was quite alkaline, being well above 7.6, but we could not measure the pH as our scales only went as high as 7.6. The pH was lower in the hypolimnion, being 7.5 at 40 feet, indicating there was a substantial rate of decomposition on the lake bottom. The secchi disc was visible to a depth of 17 feet at this date.

Water samples were taken at station #67010 on July 19, 1967 and two more samples were taken on August 19, 1967. The samples were analyzed with a Hach kit, except for pH which was determined with a Hellige color comparator, and specific conductance, which was determined with a Beckman conductivity meter (Table III).

Table III. Water Chemistry, Unnamed Lake (103-5-W4th). Samples 67029 to 67034 were taken at the Limnology Station while the other two were taken on August 19, 1967.

Sample Number	67029	67030	67032	67034	67076	67077
Depth (feet)	40	30	20	0	0	35
Temperature (°C)	8.5	13	18	21	21	13
Dissolved oxygen (p.p.m.)	3	10	11	9	9	9
Phenolphthalein alkalinity (p.p.m. $CaCO_3$)	0	0	0	0	0	0
Total alkalinity (p.p.m. $CaCO_3$)	110	130	125	120	120	125
Calcium hardness (p.p.m. $CaCO_3$)	95	90	80	90	100	80
Total hardness (p.p.m. $CaCO_3$)	145	125	120	125	115	115
Chlorides (p.p.m.)	7.5	5	5	5	5	5
pH (Hellige)	7.5	7.6+	7.6+	7.6+	7.6+	7.6+
Specific conductance (mmhos/cm @ 18°C)	-	-	-	-	190	200

The alkalinity and hardness values are high for lakes in northern Alberta. The chlorides are not particularly high, but the pH is definitely alkaline. The specific conductance ranged from 190 to 200 mmhos/cm (standardized to 18°C), indicating a substantial amount of dissolved nutrients in the water.

The limnology and water chemistry would indicate that this lake is quite productive.

PLANKTON

Plankton samples were taken at the station on July 19, 1967 and at a later date, August 19, 1967. They were 30 foot vertical hauls with a Wisconsin type plankton net (mouth diameter of 20 cm). The samples were preserved and later in the laboratory the organisms were classified and their relative abundance determined (Table IV).

Table IV. Plankton from Unnamed Lake (103-5-W4th). Sample #67010 was taken July 19, 1967 and Sample #67021 was taken August 19, 1967.

Organism	Relative abundance	
	Sample #67010	Sample #67021
Diatoms		
Asterionella	common	
Tabellaria	common	
Blue-green algae		
Anabaena	common	common
Dinoflagellates		
Ceratium	very abundant	very abundant
Rotifers	very abundant	common
Crustaceans		
Copepods	abundant	abundant
Cladocerans	common	common

There was not a great variety in the plankton samples, but there was a fairly substantial quantity in the water on both occasions that samples were taken. It may be noted that there were no green algae found in the samples.

BOTTOM FAUNA

Ten bottom samples were taken on this lake between July 16 and July 20, 1967 (Figure 3). Each sample consisted of four hauls with a six inch square Ekman dredge. These were then washed through a screen bottomed bucket (25 meshes per inch) and all living organisms preserved. The organisms were classified later in the laboratory, counted and their displaced volume measured (Table V).

Figure 3. Bottom sampling stations on Unnamed Lake (103-5-W. 4th M.)

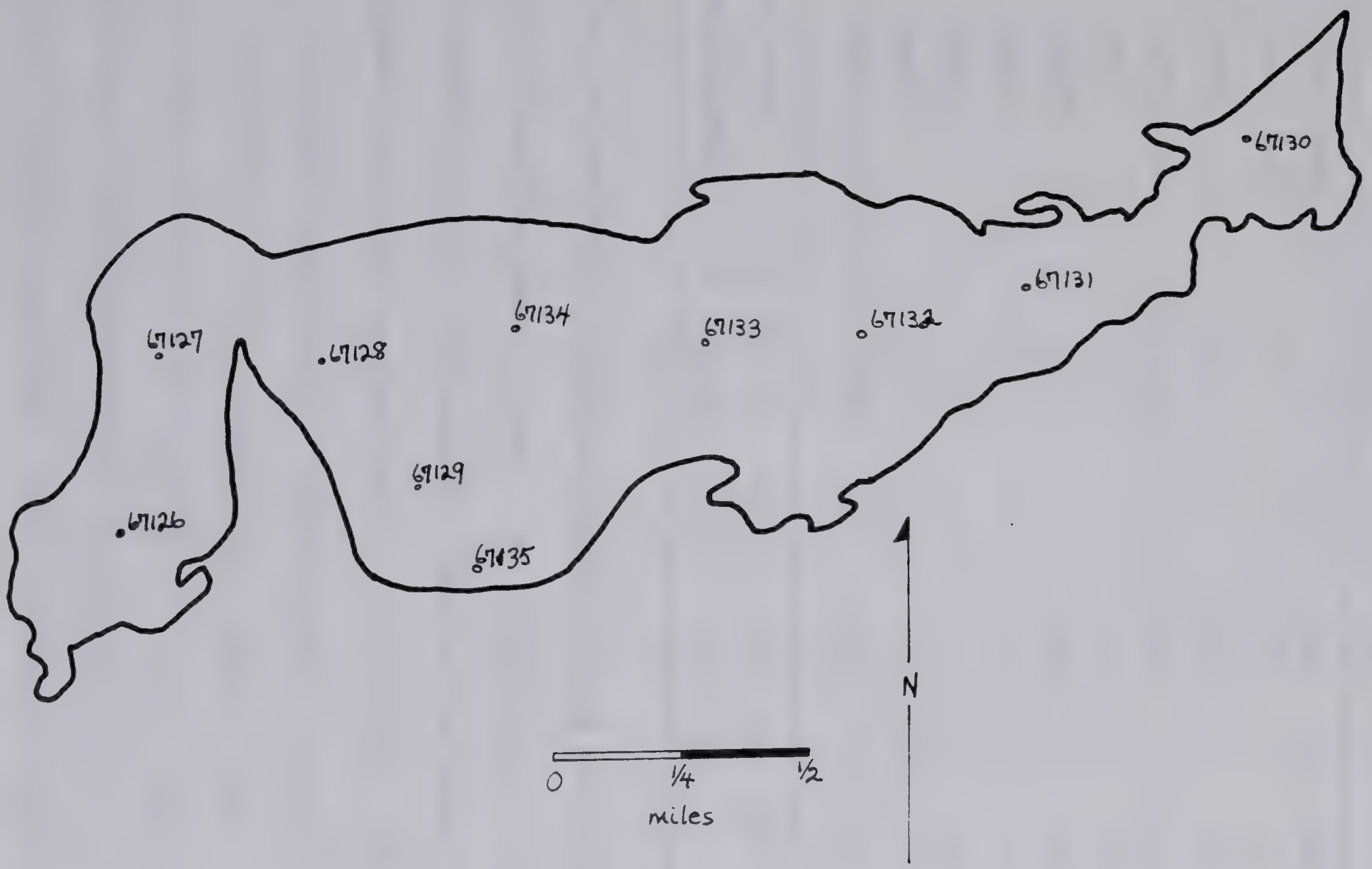


Table V. Bottom Fauna from Unnamed Lake (103-5-W4th), July 16 to 20, 1967.

Sample No.	Depth (feet)	Substrate	Oligochaeta	Hirudinea	Amphipoda	Ephemeroptera	Trichoptera	Chironomidae	Others	Total	Volume (cc)
67126	5	Sand, marl	2	-	33	11	4	26	10	86	0.55
67127	17	Muck, marl	-	-	-	-	-	3	-	3	0.05
67128	23	Muck	-	-	1	-	-	6	-	7	0.50
67129	10	Sand, marl	2	2	22	3	8	65	-	102	0.50
67130	19	Muck	-	-	-	-	-	4	2	6	0.05
67131	21	Muck	1	-	-	-	-	33	1	35	0.10
67132	51	Muck	-	-	1	-	-	-	-	1	0.05
67133	52	Muck	-	-	-	-	-	-	-	0	0
67134	35	Muck	-	-	-	-	-	7	2	9	0.10
67135	3	Sand, marl	15	7	33	7	1	15	-	78	0.50
Average/square meter			22	10	97	23	14	171	16	352	2.58
Percent of total number			6	3	28	6	4	49	5		

It can be seen from the bottom samples (Table V) that the bottom consists of sand and marl or muck. The organic muck is dark brown in color and appears to be well decomposed. Most of the shoreline is sand, and the sand has a shallow covering of marl in almost all cases. There appears to be good development of rooted aquatic plants in the shallow areas, particularly the areas shallower than ten feet. This would tend to increase the amount of available fish food organisms.

An average of 352 organisms per square meter with an average displaced volume of 2.58 cc was found. This is quite sparse and may place limitations on a population of bottom feeding fishes such as lake whitefish.

The dominant organisms in the samples were chironomids, being found in 80% of the samples and comprising 49% of the total number of organisms. The next most abundant organisms were the amphipods, being found in 50% of the samples but comprising 28% of the total number of bottom organisms in the samples. They were found in good numbers, particularly on the sand substrate. Other organisms were relatively unimportant in both numbers and volume.

FISH FAUNA

Six test nets were set between July 16 and July 20, 1967. Each net was 100 yards in length and meshes set included 2½, 3½, 4½ and 5½ inch. Fish caught included pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*) and white suckers (*Catostomus commersoni*) (Figure 2, Table VI).

Table VI. Test Net Results, Unnamed Lake (103-5-W4th), July 16 to July 20, 1967

Net Set No.	Depth (feet)	Mesh Size (ins)	Pike	Lake Whitefish	White Suckers	Total
67046	50	4½	4	6	-	10
67047	40	3½	3	3	-	6
67048	10-25	2½	9	24	1	34
67049	35	5½	-	1	32	33
67050	40	5½	-	11	-	11
67051	40	4½	2	3	-	5
Totals			18	48	33	99

No tullibee were caught in the nets, but this does not mean that this species is absent from this lake. The smallest mesh set was 2½ inches and this may have been too large to catch small tullibee which are often found in these northern lakes.

Pike

Eighteen pike were taken. All were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VII).

Table VII. Pike from Unnamed Lake (103-5-W4th), July 16 to July 20, 1967.
Number in Sample: 18

Age Class	n	♀♀	Fork Length (mm)			Weight (g)		
			$\bar{x}$	$S_{\bar{x}}$	range	$\bar{x}$	$S_{\bar{x}}$	range
III+	1	1	547			1360		
IV+	3	3	598		578-615	1890		1475-2520
V+	9	8	692	± 8.2	655-725	2268	± 84	1875-2560
VI+	4	4	712	±12.6	675-730	2490	±122	2220-2730
VII+	1	1	713			2240		

The pike in the sample ranged from three to seven years in age, and all were mature. The dominant age class in the sample was V. Fish at this age had an average fork length of 692 mm and an average weight of 2268 grams. This is quite a good growth rate for pike in this lake.

The pike in this lake probably represent a fair population of fish, and do reach good sizes. They do offer some potential for a sport fishery, although this will never be realized until this area becomes easily accessible.

Lake Whitefish

Forty-eight lake whitefish were taken. Thirty-three of these fish were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table VIII).

Table VIII. Lake Whitefish from Unnamed Lake (103-5-W4th)
July 16 to July 20, 1967.

Age Class	n	♀♀	No. Mature	Fork Length (mm) $\bar{x}$	Sx	range	Weight (g) $\bar{x}$	Sx	range
III+	9	4	3	336	± 5.2	311-357	520	± 26	400- 660
IV+	3	3	3	415		408-426	1047		960-1120
V+	9	6	9	477	± 6.9	447-515	1815	± 87	1440-2325
VI+	2	2	2	538		538-539	2390		2180-2600
VII+	5	3	5	517	± 6.0	503-539	2358	±120	2070-2720
VIII+	4	1	4	545	±12.2	513-564	2939	±246	2360-3550
IX+	1	1	1	535			2680		

The fish in the sample ranged from three to nine years of age, with age classes III and V being the most abundant. These fish appear to have a good growth rate (Table VIII) and at age class V they have an average fork length of 477 mm and an average weight of 1815 grams. They grow to a good size and could be classed as jumbo whitefish.

These fish are maturing in their third year and probably are spawning during their fourth year of life. The spawning habitat in this lake for lake whitefish is more than adequate.

Twenty-eight lake whitefish were examined for plerocercoids of Triaenophorus crassus. Six (21%) were found infected with a total of six cysts. The total weight of the twenty-eight fish was 95 pounds, which gives a rate of infestation of about 6 cysts per 100 pounds of fish.

This is quite low and these fish would be valuable on the commercial market.

White Suckers

Thirty-three white suckers were taken. Thirty of these fish were examined and the fork length, weight, sex and maturity of each recorded. Scale samples were taken for subsequent age determination (Table IX).

Table IX. White Suckers from Unnamed Lake (103-5-W4th), July 16 to July 20, 1967.
Number in Sample: 30

Age Class	n	♀♀	Fork Length (mm) $\bar{x}$	$S_{\bar{x}}$	range	Weight (g) $\bar{x}$	$S_{\bar{x}}$	range
VI+	3	3	494		485-507	1577		1075-2030
VII+	15	14	502	±3.5	480-526	1998	±47	1630-2405
VIII+	8	7	525	±3.3	510-540	2252	±57	2040-2500
IX+	3	3	524		515-533	2308		2025-2540
XI+	1	1	539			2100		

The fish in the sample ranged from six to eleven years of age, with age classes VII and VIII being the most numerous. The suckers were quite large, fish in age class VII having an average fork length of 502 mm and an average weight of 1998 grams. All the white suckers examined were mature, and it would appear from the test nets (Table VI) that these fish are quite numerous in the lake.

DISCUSSION AND CONCLUSIONS

This lake is definitely eutrophic and it would appear as though its production of fish may be quite high. Using a morphoedaphic index (Ryder, 1965) a production of 8 pounds per acre per year is postulated. Most of this would be in the form of lake whitefish and a harvest of 5 pounds per acre does not seem unreasonable. This would mean an annual harvest of approximately 4100 pounds of lake whitefish. Since these fish have a very low rate of infestation of the pike-whitefish tapeworm, they are quite valuable. The pike grow to a good size in this lake and do offer some sport fishery potential. Utilization of this potential will probably not be realized until this lake becomes easily accessible.

DISCUSSIONS AND CONCLUSIONS

From the foregoing reports it can be seen that there is actually very little sport or commercial fisheries potential in this area. Most of the lakes appear to have lake whitefish and pike as the main species present and in most cases the pike are quite small and the lake whitefish too heavily infested with the pike-whitefish tapeworm to be of much value to a commercial fishery.

Lakes in this area which do have some potential are Larocque Lake, which has a whitefish population (although small in size) which is free of the pike-whitefish tapeworm, Unnamed Lake (107-4-W4th), which has a population of lake trout and a population of pike which reach a good size and an Unnamed Lake (103-5-W4th) which has a population of pike which reach a good size and lake whitefish which have a very low infestation rate with the pike-whitefish tapeworm.

REFERENCES

Ryder, R., 1965. A method for estimating the potential fish production in north temperate lakes. Transactions of the American Fisheries Society, Volume 94, Number 3, pp 214-218.

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